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THE HUDSON RIVER TUNNEL has about reached the lowest point in its total length of 5,500 ft. A 2% ascending gradient is now to be followed, and Messrs. A. Pearson & Sons, the contractors, have obtained from the War Department permission to cover the comparatively thin layer of silt, that would otherwise cover the tunnel roof, by a bed of well-tempered clay. The present depth of water at this low point is from 60 to 64 ft., and the plan shows in some cases only 5 ft. of river mud between the tunnel roof and the river bottom. As the air-pressure now used is about 25 lbs. per sq. in., and this would have to be increased, it is evident that the shell of mud is not sufficiently thick to hold it. To go deeper into the river bed means rock excavation, an exceedingly difficult and dangerous operation with the present plant. The Board of Engineers has granted the application on condition that not more than 20,000 cu. yds. of clay be used in all, and that the clay bank nowhere rises more than 15 ft. above the present bottom, nor anywhere above 31½ ft. below low-water level in the river. This material must also be removed to the original depth on the completion of the tunnel. The company must also give a bond of $200,000 for the faithful performance of their work under the above conditions, and pay for any damage to piers.

HIGH EXPLOSIVES IN SHELLS are to be tested by the Ordnance Department, the Midvale Steel Co., having contracted to make the steel shells required. These shells will be 7 ins. diameter and are to be loaded with gun-cotton, melinite, dynamite, emmensite, amencanite, explosive gelatine, rack-a-rock, etc., The object of the test is to determine the most powerful exposive that can be fired with safety from modern high-power guns.

A RAILWAY BALLASTED WITH SALT, as is a portion of the Southern Pacific across the Colorado desert, is peculiar enough to be classed with the Durango Railway, in Mexico, that is ballasted with silver ore from an old dump, and laid with ties of ebony.

THE MARKET ST. ELEVATED RAILWAY, recently chartered in Philadelphia, was so handicapped with conditions, $2,000,000 security against consequential damages, etc., that there is no hopes for its construction under the present charter. This was probably the intention of the City Councils, but the promoters say they will make a vigorous attempt to have the charter modified in the fall meetings. Naturally, there were no bids for construction on the day fixed for receiving them.

THE WHEELING, VA., WELL, that is now dedicated to science for the purpose of studying the temperature of the earth's crust, was bored to a depth of 4,000 ft. by the Wheeling Development Co. for oil, and then abandoned. By the advice of Prof. I. S. WHITE, of the Virginia State University, it was not wrecked. It has since been drilled deeper, and is now 4,500 ft. deep, 4¼ ins. diameter, is cased for only 1,570 ft., and is almost perfectly dry, having but a few gallons of water in the bottom of the hole. Generous contributions in the cause of science will enable it to be pushed still further downward. The fact that it is not cased to its bottom is fortunate for the purpose on hand, and barometric pressure can be measured in the naked rock bounding this hole 3,700 ft. below sea level. As compared with other wells and in this connection, we have the 4,000 ft. well at Sperenberg, near Berlin, and the 5,740-ft. well put down by the German government at Schladebach. But while the observations made at both these wells are accepted as the most reliable information we have upon the rise in temperature as the earth's crust is penetrated, both of these wells are full of water, and the last-named is cased nearly to the bottom. Much data of value is expected when the U. S. Geological Survey finishes its investigations at the Wheeling well.

HEAVY RAPID-FIRE GUNS are to be submitted to a competitive test by the Ordnance and Fortification Board of the War Department. The test is to be made at Sandy Hook extending over six months, and will exceed anything of the kind before attempted in the United States. Among the guns submitted will be the Hotchkiss, Canet and Armstrong types. The Hotchkiss will be 4.7 ins. calibre, firing a projectile of 55 lbs. at the rate of 13 per minute. The other two will endeavor to outdo the rapidity, penetration and strain records of the Hotchkiss. The 3 94-ins Hotchkiss, firing a 33-lb. projectile, has a record of six aimed shots per minute with, a muzzle velocity of 1,970 ft. per second and a penetration in steel at the muzzle of 7.1 in. The Canet 3.94-in. gun, with a 28.7-lb. projectile, has fired 6 aimed shots per minute with a muzzle velocity of 2,493 ft. This is with smokeless powder, and with the same powder the Hotchkiss has given velocities of 2,339 ft. and the Canet 2,623 ft. per second. But in order to obtain these velocities the Canet gun was subjected to a pressure of 16.8 tons per sq. in., against 14.4 tons for the high velocity of the Hotchkiss. The 4.72-in. Armstrong gun, it is claimed, will throw a 57-lb. projectile at the rate of 12 shots per minute. All these guns vary in their breech mechanism, but weigh about the same. The Hotchkiss is said to be the most durable gun of this type, owing to the quality of metal used and the methods of its manufacture. The steel used must stand a test strain of 96,000 lbs. per sq. in.

THE MOST SERIOUS RAILWAY ACCIDENT which has occurred for some time past, was a rear collision, July 3, on the New York, Lake Erie & Western R. R., at Ravenna, O. A passenger train had stopped at that place on account of repairs needed to one of the couplings, and as this was not a scheduled stop the rear brakeman should have gone back at once to signal any following train. He delayed for some little time, however, according to the reports, and was not in time to warn a fast freight train which was approaching at high speed. A special car at the rear of the train and one of the sleeping cars were wrecked, and both these cars with the second sleeping car were burned. There were 19 persons killed and about 10 injured. Several of the former were injured by the collision or caught in the wreck, and were burned to death. The responsibility of the accident appears to rest with the brakeman. The fire was started either from the engine or the car lamps. We have referred to this accident in our editorial columns.

ANOTHER SERIOUS ACCIDENT, about as bad as that at Ravenna, occurred July 4, near Charleston, W. Va., on the Kanawha & Michigan R. R. A passenger train ran onto a trestle, some of the ties of which had caught fire. The engine and the baggage and mail car got across in safety, but the two passenger cars left the rails and went over the trestle, which was about 20 ft. high. There were 14 persons killed and between 30 and 40 injured, some fatally.

A TRESTLE on the Western North Carolina R. R. near Newton, N. C., gave way under a freight train June 30. The trestle was 40 ft. high. The engine and some of the first cars got across in safety, but all the rear portion of the train went down. One man was killed and 3 were injured.

THE LAKE IN THE COLORADO DESERT is due, says Major POWELL of the Geological Survey, to the overflow of the Colorado River, which has probably cut a new channel to the northward. Major POWELL says that as recently, geologically speaking, as the glacial period, the Colorado River emptied into the Gulf of Mexico about 200 miles below what was then the head of the Gulf. This river is the greatest carrier of silt on the continent, and it gradually built a dam across the Gulf that finally cut off 200 miles in length of the Gulf itself. The water thus confined evaporated and a depression called Death Valley is the result, that in part is 270 ft. below sea-level. The climate here is wonderfully dry and the rainfall is only about 3 ins. per year.

THE MANCHESTER CANAL has had the water of the Mersey admitted to the finished eastern sections. The work between Ellesmere Port and the River Weaver is well advanced and water will be admitted soon.

THE PNEUMATIC DYNAMITE GUN CO. is in trouble, as a judgment of $124,507 has been just filed against it by William Cramp & Sons, mainly for work done on the *Vesurius*. This company was incorporated July 12, 1884, with a capital of $1,000,000, increased to $1,100,000 in Nov., 1888. The president of the company is Mr. SPENCER D. SCHUYLER.

THE BRIDGES of the London, Brighton & South Coast Ry., of England, have been inspected by Sir JOHN FOWLER, M. Inst. C. E., since the bridge failure mentioned in our last issue. The inspection was made on behalf of the company, and the report recommends that 20 of the bridges be rebuilt within 12 months, and 60 more within 2 or 3 years. The report also states that the considerations leading to these recommendations affect several other railways, so that the result of the Portland Road accident is likely to lead to a very general investigation of railway bridges, especially on the less important lines and branches.

WIRE FINER THAN A HUMAN HAIR is now made, not as a curiosity, but as a regular commercial product. The wire industry is one of those which has been enormously developed by the demands of the electrical arts. Two samples of fine wire recently received from Bradford, Kyle & Co., of Plymouth Mass., are before us. One is a copper wire .002 in. in diameter, and covered with a green silk insulation .00175 in. thick. In appearance this wire is as fine as the finest human hair. Those interested in curious mathematical illustrations of the great and small may be interested to know that a pound of this wire would reach nearly 16 miles, so only about 6 lbs. would be needed to build a telegraph line from New York to Philadelphia. Lest any one may be tempted to embark in this enterprise, however, we will say that the electrical resistance of the wire is 2½ ohms per ft.

Another sample received from the same manufacturers is an aluminum wire .005 of an inch in diameter, insulated with a covering of white silk.

AUTOMATIC COUPLERS AND TRAIN BRAKES have been under discussion by the Michigan legislature, and a joint resolution has been passed as follows:

That the Congress of the United States is hereby earnestly requested to enact such legislation as may be necessary to insure the adoption on all railroads in the United States of automatic couplers and train brakes; or such other legislation as may be necessary to insure the making up and running of trains without compelling railroad employees to enter between or on the tops of cars while the same are in motion.

The passage of this resolution is due largely to the efforts of Railroad Commissioner CHAS. R. WHITMAN, whose memorial to the Governor on the subject is embodied in the resolution as a preamble.

The Colorado River Dam at Austin, Tex.

We are indebted to Mr. J. P. FRIZZELL, Chief Engineer, for the accompanying information and for the illustrations of the dam across the Colorado River at Austin, Tex. The dam is now under construction by the city of Austin and is designed to furnish power for pumping the city water supply, for electric lighting, for propelling street cars and also for general manufacturing purposes.

The general character of the dam and its surroundings is shown by the plan and sections presented herewith. In brief, it may be stated that the dam is of masonry, about 1,150 ft. long, with a height of 60 ft. above the summer level of the river and a width of 18 ft. on top. The inner face of the dam is vertical. The outer face has a batter of 3 in 8 for 40 ft. from the top and from the foot of the batter to the low-water line it is curved with a radius of 31 ft. The foundation being rock it was not necessary to carry the dam below the natural bed of the river, except at the foot of the faces and for two longitudinal courses of large stone near and on each side of the center, as shown by the cross-section. The alluvial deposit was of course removed from above the rock, the extent of which is shown by the longitudinal section.

The Colorado at this point flows in a deep gorge in limestone rock, which, with the bluffs, often rise 150 ft. above the bed of the stream. There are no extensive bottom lands, so a dam can be constructed with but little cost for land flooded. In its normal condition the river occupies but a small part of the gorge, the remainder being filled with alluvial deposit, as shown by the section already alluded to.

The site of the dam is about two miles from the city, where the walls of the rock channel rise over 60 ft. on the city, or east, side of the river and 125 ft. on the other side. The lower bank of the stream slopes gently from the dam and affords sites for power and pumping stations and other buildings that may be necessary or desirable. The canal for conveying water to the wheels is at this side of the dam, and is provided with a gatehouse at its head. The water will pass from the canal to the wheels through iron pipes. From the wheel pits underground races will carry waste water to the river. The excavation for the canal will be in rock. As shown by the drawings the canal will have a width of about 90 ft. and a depth of some 15 ft., but it is not stated that these dimensions have yet been permanently decided upon.

The river above Austin drains about 40,000 sq. miles, and the estimated maximum flow at the highest water remembered is estimated as 250,000 cu. ft. per second.

To May 30, 1890, the work on the dam had been the construction of cofferdams, excavation of earth and rock, installation of pumping and hoisting machinery, the construction of railway tracks, including a road about four miles long from the Austin & Northwestern Ry. Co.'s station in Austin to the site of the dam. In addition the laying of stone had been in progress nearly all the month.

The exterior of the dam is of cut granite, the interior of limestone, all in blocks as large as the machinery can handle. The course under the curved slope consists of granite blocks measuring from 65 to 80 cu. ft. each. The granite is obtained in Bennet Co., Tex., about 80 miles from the works, and arrives on cars under the east end of the cable. The limestone is obtained from quarries near the dam, and is brought on cars by gravity under the west end of the cable. The stone is transferred from the cars to the work on the cable, the granite suspended from the traveler by "dogs," the limestone in skips. The stone is laid by means of small, stiff leg derricks resting on triangular horizontal sills. These derricks are shifted from point to point by means of the cable. About 18,000 cu. yds. of granite and 70,000 of rubble will be required in the work. The contractor's price for the granite is $11 to $15 per cu. yd.; for rubble, $3.60, with 50 cts. additional in each case when Portland cement is used. The granite is laid with full mortar joints, especial care being taken to secure water-tightness on the up-stream face. The interstices in the rubble are filled with concrete of river gravel carefully screened and mixed with an excess of mortar. Two sorts of gravel are used, one not exceeding the size of hickory-nuts, for bedding heavy stone and for filling smaller joints; the other up to the size of hen's eggs, for larger spaces. All joints are left sufficiently open to admit of packing the concrete.

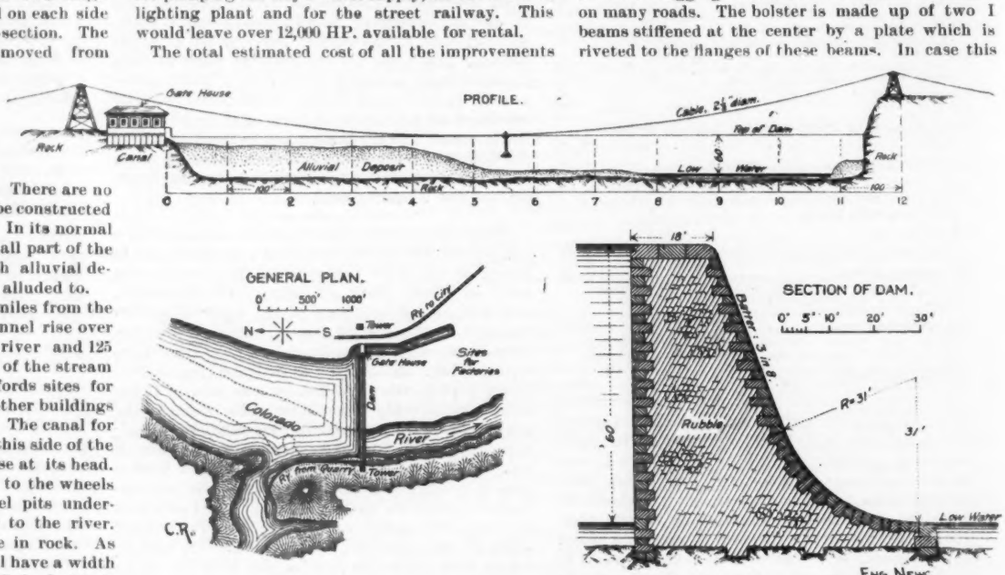
The estimates of the cost of the dam proper, without allowances for gates and canal, are as follows:

Cofferdam, filling and draining	$6,200
Earth excavation below water, 10,000 cu. yds., at 5 cts	5,000
Earth excavation above water, 58,000 cu. yds., at 15 cts	8,700
Rock excavation, 8,150 cu. yds., at $1	8,150
Rubble masonry, 54,550 cu. yds., at $4	218,200
Limestone masonry in up-stream face, 6,800 cu. yds., at $10	68,000
Granite masonry in down-stream face, 9,000 cu. yds., at $13	117,000
Capstones, 2,000 cu. yds., at $16	32,000
	$463,250

Mr. FRIZZELL estimates the available horse power to be developed at 14,636 for 60 working hours per week. Of this, 720 HP. each are allowed for power for pumping the city's water supply, for the electric lighting plant and for the street railway. This would leave over 12,000 HP. available for rental.

The total estimated cost of all the improvements proposed, including the dam, gatehouse, canal, pumphouse and accessories, a reservoir and mains for distributing the city water supply and an electric-lighting plant, is about $1,300,000.

Mr. BERNARD CORRIGAN, Kansas City, Mo., is contractor for the dam, and, as has been stated, Mr. JOSEPH FRIZZELL is Chief Engineer. Mr. JOHN BOGART, C. E., of New York, is Consulting Engineer.



COLORADO RIVER DAM, AUSTIN, TEX.
J. P. Frizzell, Chief Engineer.

A Steel Stock Car.

(WITH INSET.)

Within the last few years there has been a decided increase in the use of steel in car construction, and the manufacture of cars entirely of steel has been frequently suggested. A few experimental cars of this kind have been built, but it is only lately that the construction of steel cars has been commenced as a regular commercial business.

The Harvey Steel Car Co., of Chicago, Ill., has built a number of box, coal and flat cars of steel, and we illustrate on our inset sheet this week a stock car which is one of the company's latest types, and 15 of which it is building for the Chicago, Milwaukee & St. Paul R. R. This car is constructed entirely of steel, except the floor and the slats on the sides. The car is 34 ft. long and 8 ft. 6 ins. wide inside. The length over the roof is 35 ft. 6½ ins. and width 9 ft. 7 ins., while the height from rail to top of roof is 12 ft. 0¾ in. The capacity is 60,000 lbs. The framing is mainly of channel and angle irons, the arrangement of which is very clearly shown in the working drawings. Each side is divided into 7 panels, the middle one forming the doorway. There are two truss rods, ⅝-in. diameter, placed close to the center line of the car, and 2 ft. 7 ins. apart, center to center. The floor is of 3 × 8 in. Norway pine planking, tongued and grooved. The sides are of white pine planks, placed horizontally and with spaces of 2 ins. between them. The bottom plank is 9¾ × ⅞ ins., placed 1 in. above the floor, and above this are four planks 7¾ × ⅞ ins. Above the planking the sides are steel plate with horizontal corrugations. The ends are of pine planks 1 × 6 ins., grooved and tongued. The doorway in the middle of each side of the car is 6 ft. 4 ins. high and 5 ft. 3 ins. wide in the clear. The door is hung from an overhead rail and slides along the side of the car. The lower part of the door is of steel plate and the upper part of wire netting, the space between being filled in by ⅝-in. round bars. The car is carried on two four-wheel trucks, with 33-in. wheels. The truck-wheel base is 5 ft., and the distance c. to c. of trucks 24 ft.

The trucks are a special feature of the Harvey cars. They are entirely of metal with the exception of the wooden dust guards. Wheels, boxes, brasses and brake rigging are made to a standard common on many roads. The bolster is made up of two I beams stiffened at the center by a plate which is riveted to the flanges of these beams. In case this bolster should be damaged in service it can be replaced by a timber 12 × 12 ins. The Middleton spring is used, but any form of spring can be applied. The bolster weighs less than an ordinary flitch bolster made up of two ¾-in. plates, timbers and bolts. The axles are 4¼ ins. diameter and 8 ft. long, with journals 4⅝ ins. The wheels weigh 600 lbs. each, and the spring plank 20 lbs. per ft. The trucks weigh about 5,500 lbs. each.

The steel cars built by this company are said to weigh 10% less than an ordinary wooden car, and it has built cars 15% lighter than similar cars of wood. In regard to the cost, it is reported that 25% will cover the increased cost of these metal cars over cars on wooden frames, while this increase is more than balanced by the increased life of the car and the value of the material as scrap. As to the behavior of cars in collision, it is stated that the steel cars will withstand a very severe collision without injury. In case of their being thrown from the track and other cars piled upon them they will break or bend, as builders cannot be expected to make cars that will not get out of shape in very bad accidents. A large part of a Harvey metal car can generally be taken from a wreck and straightened, owing to the peculiarity of the construction, and put back in place. There is but little information as to the cost of maintenance in this country, but in France, Germany and other parts of Europe the cost of maintenance of metal cars is said to be considerably lower than that of wooden cars, the painting being the principal item of expense, while ordinary repairs are very slight for the first 10 years. Wooden cars depreciate about 6% per annum from the first. Metal box cars, with sides of vertical plates riveted together, and with metal frames, are in use on railways in

England, France and other countries, but are generally short cars on four or six wheels. A steel mail car was put on the Louisville, New Albany & Chicago R. R. in 1888, and up to September, 1889, had made a total of about 88,000 miles, and had not cost anything for repairs.

The use of metal for stock cars will tend to greatly increase their life, as they are all the time being washed out and then left to dry, so that wooden cars will decay in a few years so badly as to demand renewal. The Harvey car which is here illustrated appears to be of good and strong design, and likely to give satisfactory results in service. The use of steel cars is at present in the experimental stage, but they appear to present many advantages over wooden cars, and if the advantages are proved by actual experience there is likely to be a good chance for the steel-car companies.

Notes on French Railways.

The time spent by the writer in France and the extent of traveling done were too limited to permit of a complete study of the French railways, and the present article will give therefore merely some notes made during a few journeys. Notes on the channel steamers have been given in ENGINEERING NEWS, March 14 and 21, and April 11, 1891.

WESTERN RAILWAY.

Track.—The track consists of double-head rails carried in cast-iron chairs secured to the cross ties by a screw spike on each side of the chair. The rails are laid with square suspended joints, spliced by straight splice bars and 4 bolts, with the nuts on the outer side. The car wheels pound very heavily over these joints. Deep splice bars, projecting below the rail, are occasionally used. The ballast is of gravel, level with the tops of the ties between the rails, and filled up to the rail head on the outside. It was overgrown with grass and weeds, and in some places was being hoed like a garden path. The ties are creosoted, and have the chairs attached before they are sent out to the track. At intervals along the line are stacked 3 rails, 2 ties, about 6 chairs, splice bars, bolts and other track material, all neatly arranged in a frame. The ties are suspended from a frame made of old rails, so as not to rest on the ground and rot. Portable railways are used in the gravel pits. The grade boards are rectangular, painted blue, with a white line and arrow head showing the direction of the grades, and white figures indicating the inclination and length of the grade. Hedge fences are used. The slopes of cuts and fills are covered with grass, which is mowed for hay in the summer. The starting signals are rectangular targets about 24 × 30 ins., divided into 4 squares, generally red and white, but some green and white; the block signals are disk targets, red in the middle, with a white rim. The disk has a small piece of colored glass set in a hole in front of the lamp. In some cases the glass for the "track clear" signal is at right angles to the disk, coming in front of the lamp when the disk is turned. The signal wires are kept tight by means of weights suspended in a frame by chains, to which the wires are attached, as shown in Fig. 1. Just outside the St. Lazare terminal station at Paris is an iron lattice deck bridge carrying the starting signals for the several tracks. Signs are put up to mark the limit of protection of the distant signals ("Limite de la protection du signal avancé"). At grade crossings there are inner iron guard rails, with a paving of stone blocks about 8 ins. square.

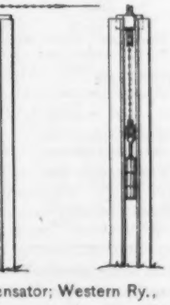


Fig. 1.—Signal Wire Compensator; Western Ry., France.

There is a watchman at each crossing, and sometimes an iron lattice gate, rolling on a rail parallel with the track. The insulators on the telegraph posts are of white earthenware or porcelain. The station platforms are only about 12 ins. above the rails, so that step-boards or foot-boards are required on the cars, which is a very inconvenient means of access, the steps being nearly vertical, and the doors opening above them. The St. Lazare station has a large and lofty train shed and a handsome building facing on the street. The station at Rouen has inside guard rails to the tracks, and is paved with stone. At this place are extensive shops, including a large roundhouse and steam turntable. There are several tunnels on the line, most of them with brick lining. One long tunnel under repair had only one track in use, and an illuminated sign with white letters on a black ground was placed near where the work was in progress, warning the engine driver to go slowly ("Au pas sur le chantier"). In some places the line is parallel with a highway, separated from it by a hedge or fence. One bridge over the Seine has a track of flange rails secured to longitudinal timbers by screw spikes through the flanges, the longitudinals being held down by bolts passing through iron plates across the top of the timber. The floor is of checkered iron plates level with the bottom of the longitudinals.

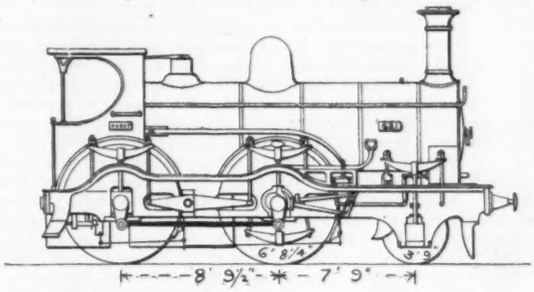


Fig. 2.—Passenger Locomotive; Western Ry., France.

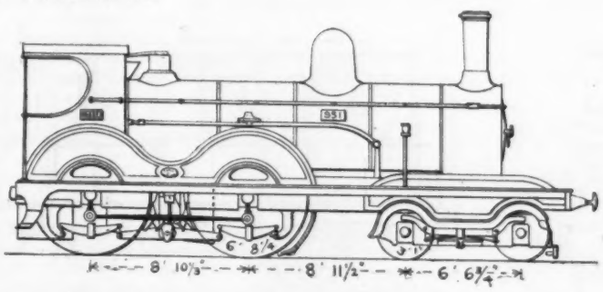


Fig. 3.—Eight-Wheel Passenger Locomotive; Western Ry., France.

Locomotives.—The two principal types of passenger engines are shown in Figs. 2 and 3, the latter being a neat looking engine of the eight-wheel type, with inside cylinders and equalizing levers to the driving springs. A side tank engine was seen, with outside cylinders and eight wheels, all coupled. Most of the older engines of this and other French lines have a great deal of outside piping and running gear, which gives them a clumsy appearance. The Westinghouse driving-wheel brake is used. The whistles have a shrill hissing sound. Coal briquettes are much used for fuel. The engines are painted a dark brownish green, with black and red striping.

Rolling Stock.—The passenger cars are carried on 4 wheels, with rigid axles, and are divided into 4 or 5 compartments. They have outside journals and springs and squeeze brakes. The second-class cars are comfortably upholstered in soft, dove-colored cloth, but the floor is bare, and the roof painted a dull yellow. An oil lamp is placed in the top of the partition, being intended to light both compartments, but its light is dim, and is rendered almost ineffectual by the hand baggage piled in the rack along the partition. The windows at the ends of the seats are narrow, but have sashes which open by dropping down into the side of the car, in the same way as the sashes in the doors. In each partition is a glass panel about 4 × 8 ins., intended to afford means of verbal communication between the compartments in case of emergency. Communication with the engine driver or conductor is effected by a wire or rod inside a molding along the roof, with a knob in each compartment. Some of the cars have glazed ends, with only one seat in the end compartments. The windows in the doors are fitted with roller blinds, and the others with loose curtains. Below the door handle is a latch, provided for additional security. The Westinghouse brake is used, some of the cars having hose couplings, while others have iron pipe connections with swivel joints. The wheels have wooden centers recessed for the nuts of the bolts which fasten the tire to the rim. Some of the cars have a protected seat for a conductor or brakeman at the end of the roof, with steps up the end of the car. The cars are painted black above the window sills and the lower part is crimson for the first class, light dull green for the second class and dark green for the third class cars. The numbering is in gilt and the hand rails are of bright brass. The freight cars are generally carried on 2 rigid axles and a large proportion are short open cars, some of which have an elevated protected seat at one end for the brakeman. Many of the box cars have painted upon them the number of horses and men they can carry. This is to facilitate the mobilization of troops. The freight cars are painted a dark gray. The boat express is run at a fair speed, but the cars bump and jolt badly. When a train is to start a station porter rings a bell, the conductor blows his brass horn and then the engine whistles. The officials wear a dark blue uniform with white braid and silver buttons.

CEINTURE RAILWAY.

The "Belt Railway" of Paris is a double-track line around the outskirts of the city, making connections with the several trunk lines, and having a branch into the terminal station of the Western Ry. The line passes through the fortifications in one place by a deep cut, with retaining walls of large rubble masonry. In some cuts the retaining walls are nearly vertical, with iron cross beams above the track, while in other places they are curved and have a very flat slope. The masonry is mostly smooth faced rubble, but there is some coursed masonry. One long tunnel has the shafts at one side, forming refuges for the trackmen. Some parts of the line are in covered way, with a roof of transverse plate girders and brick arches. One of the crossings of the Seine is by a double-deck bridge of masonry, the lower part being wide enough for a roadway on each side of the narrower arches which carry the railway. The station platforms are low, and have stone copings. The name of the station is on a sign at each end of the shed over the platform, and signs are put up on the platforms to indicate where the head of trains of 8, 10, 15 and 18 cars will be. Small stations have a ticket office on one side only, with a subway crossing to the other platform. Before starting a train the conductor blows his whistle and then his brass horn, which is replied to by the engine whistle. The speed is slow, and much time is lost in slow stopping and starting. The actual stops average about 1 min. The engines have frequently to back a little before they can start ahead.

Track.—The part of the line laid with double-head rails in chairs has generally 10 ties to a rail, but some long rails are used with 18 ties. The wooden keys are on the outer side of the rail, and have a sharper taper than those of English railways. Where flange rails are used they are fastened by screw spikes, with broad round-head bearing on the rail flange, and a square projection on top of the head to fit the track wrench. The rail ends are considerably worn. There are seven ties to a rail. All

rails are laid with square suspended joints, spliced by plain splice-bars and four bolts, with the bolts on the inner side of double-head and outer side of flange rails. Some tee head track bolts are used for the latter, the inner splice bar being grooved to hold the heads. The flange rails are generally carried across bridges on longitudinal timbers with bearing pieces under the rail, but in some cases cross ties are laid, with a block under the rail joints. The ballast is of broken stone, covering the ties between the rails, and heaped up to the rail head on the outside. In some cuts the ballast is retained by dwarf walls in cement. The station at Auteuil has through and terminal tracks, and each of the latter has a turntable at the end. The signals are similar to those of the Western Ry., but the rectangular targets are generally green and white. Some of the signals consist of a long semaphore blade with a fixed board to conceal it when in one position. The signal wires are kept tight by the arrangement shown in Fig. 1, but each vertical post is made of an old double-head rail, with the end of the cross piece let into the web.

Locomotives.—The line is operated mainly by the Western Ry., and partly by the Eastern Ry. The former has two classes of six-wheel, side tank engines, one with four wheels coupled and a single pair of leading wheels, the brake reservoir being placed outside these wheels, and the other with all wheels coupled, as shown in Fig. 4. The Westinghouse brake is used.

Rolling Stock.—The trains consist of 8 to 18 short four-wheel cars. The first class cars have three compartments only. The second and third class cars have four compartments, and many of them have an upper deck or "imperial," reached by steps from either side up each end of the car. The upper deck is narrower than the body of the car, leaving a narrow, unprotected gangway along each side, passengers getting in and out steadying themselves by a rail along the edge of the upper roof. The seats are arranged as in the compartments, but accomodate four instead of five passengers each, the capacity being 40 inside, and 32 or 36 outside. The lower roof is covered with a mixture of tar and gravel. The upper deck has a roof and ends, but the sides are open. This deck is not very pleasant, the roof being so low as to limit the view (one cannot stand upright under it), and there being a good deal of smoke and cinders from the engines, while the chimneys of the lamps for the compartments are under the seats and emit an unpleasant smell and smoke. The upper deck of smoking cars is inclosed, having a door in each end, and a gangway down the middle, with seats for two on each side. These cars carry about 40 passengers in the compartments and 40 in the "imperial." The upper deck has bare seats and floor and is very dirty, and the windows have iron bars. These cars have the compartment lamps at the side, the chimney projecting through the roof at the side of the upper deck, while the upper deck has in each end a lamp of remarkable dimness, giving out no light, but merely showing as a smoky, yellow disk. The other double deck cars have generally a lamp between two compartments and no lamps in the upper deck. The lamps are lighted all the time on account of the tunnels. Some of the cars have the corners cut away, so that the steps to the roof are somewhat spiral, and others have a brake wheel in a recess at the end of the upper deck. The compartments have sliding sashes to all the windows. The conductor's car at the rear of the train has a part of the roof raised and surrounded by windows, and has a large tail light with glass 8 or 10 ins. diameter, protected by a brass triangle. The cars have spring buffers, screw-couplings, safety chains and the Westinghouse brake. The wheels have wood centers and the tires are fastened by bolts. The cars are painted like those of the Western Ry. On July 14 (equivalent to the Fourth of July in the United States) the trains were loaded with people going to the review, passengers riding on the steps, footboards, and even on the roofs.

NORTHERN RAILWAY.

Track.—The track consists of flange rails fastened to the cross ties by screw spikes. The rails are laid with supported joints, spliced by straight splice bars and four bolts, with the nuts on the inner side, and each rail end has a screw spike on each side. The joints are very perceptible while riding over the line. The ballast is mainly of gravel, level with the tops of the ties between the rails and level with the lower part of the rail heads outside. There is also some large broken stone or slag. Some half round ties are used and there are 10 ties (including one joint tie) to a rail. The ballast is carried across some bridges, and north of Quevy, where baggage is examined for the Belgian frontier, it is of very dirty gravel. The roadbed is overgrown with weeds. The new long rails, weighing about 83 lbs. per yd., with broken stone ballast, make a track not unlike that of the Pennsylvania R. R. Hedge fences are used. The signals are of the pattern already described. There are also semaphore blades with vertical slots cut in them. Switch signals consist of a blade pivoted at the middle in a box of triangular form, so that only one-half of the blade is shown at a time, indicating for which track the switch is set. The signals at road crossings are generally attended by women in blue blouses and black glazed hats. The signal wires have the arrangement shown in Fig. 1, but the posts are of wood. The telegraph wires are brought down at intervals into small concrete cabins along the line. In some places the track is pretty easy riding, but in general there is a severe swinging and vertical motion of the cars, due to the irregularities of the track, the arrangement of the springs and the short wheel base.

The terminal station at Paris has a large wide platform beyond the ends of the tracks, with "quais" or platforms running out between the tracks, and provided with gates to shut them off from the main platform. Each "quai" is numbered, and signs are displayed near the gate showing the time of departure and the stopping places of the train standing at that "quai." These signs are illuminated at night. Each track has a turntable at the outer end of the train shed. The yards are extensive, but are overgrown with weeds and poppies. Horses are extensively used in switching cars in making up trains.

Locomotives.—For express service eight wheel engines are largely used, some of which were built by the Société Alsacienne, at Mulhausen, in 1879 and 1881. They have inside cylinders, plate frames to the trucks, and sometimes the eccentrics are outside the driving wheels. The truck and tender axles have outside bearings of the Delannoy system. These engines have straight smokestacks and very large domes. A quantity of dirty black smoke is thrown out. The exhaust sounds sharp, as on American engines. The whistle is harsh and unpleasant, and is much used at stations and junctions. The tenders are very plain and have no flaring molding round the top. The vacuum brake is used. At the Paris terminus is a little switch engine, with vertical boiler, used for hauling a transfer table. Under one end are a horizontal drum and driving cylinder with a wire rope used by means of a capstan for hauling cars at right angles to the engine. The engines are painted a dark, dull, brownish green. Some have the boilers covered with brass, but the metal is generally tarnished and dented, and does not look well. Compound engines of three types have been tried on this road: (*A*) An engine with 4 coupled driving wheels 6 ft. 10 ins. diameter, and a single pair of leading wheels 4 ft. 3 ins. diameter; 2 high pressure inside cylinders, 12 × 24 ins., drove the forward driving wheels, and 2 low-pressure outside cylinders, 18 × 24 ins., the rear wheels. (*B*) An engine of the Woolf four cylinder type, with 8 coupled driving wheels 4 ft. 3 ins. diameter, and 2 outside cylinders arranged tandem on each side; the high-pressure cylinders were 15.2 × 26 ins., and low pressure 26.4 × 26 ins. (*C*) A three-cylinder engine of the mogul type, with all cylinders in line transversely, inclined, and driving the same axle. The inside high pressure cylinder was 17 × 28 ins., and the two outside low-pressure cylinders were 20 × 28 ins. The wheels were about 5 ft. 5 ins. diameter.

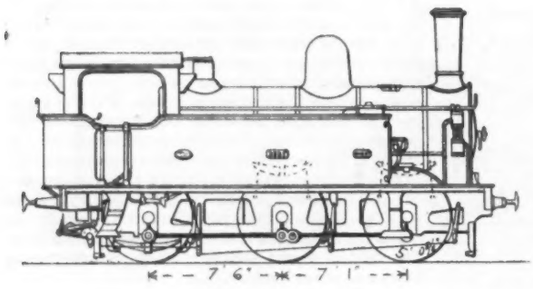


FIG. 4.—TANK ENGINE; CEINTURE RY., PARIS, FRANCE.

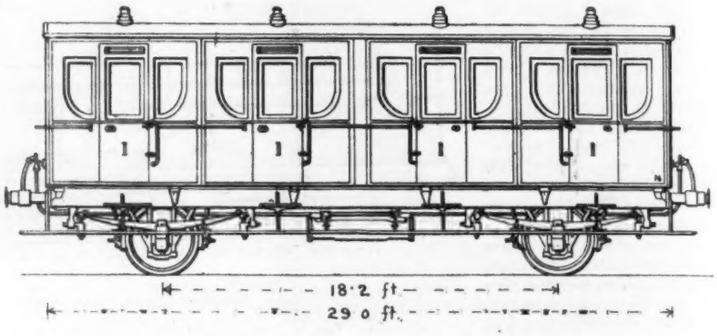


FIG. 5.—PASSENGER CAR; NORTHERN RY., FRANCE.

DIMENSIONS OF FRENCH LOCOMOTIVES.

	Fig. 2 W. Ry.	Fig. 3. W. Ry.	Fig. 4. C. Ry.
Cylinders. ... ins.	17 × 23½	18.1 × 26	17 × 23½
Diam. truck or leading wheels.	3 ft. 9 ins.	3 ft. 1 in.	.....
Diam. dr v. whls.	6 ft 8¼ ins.	6 ft. 8¼ ins.	5 ft ¾ in.
" boiler ...	4 ft. 11⅛ ins.	.....	4 ft.
Boiler pressure...	.....	156.4 lbs.	142 lbs.
Tubes, No	223	195	203
" diam..ins.	1 8	{1 77 / 1.93}	1.77
" length	10 ft. 6 ins	.....	11 ft. 7¾ ins.
Heat surf.: tubes	1,086 76 sq. ft.	1,343.7 sq. ft.	1,037 16 sq. ft.
" firebox	103 30 "	106 "	75.35 "
" total..	1,190.06 "	1,449 7 "	1,112 45 "
Grate area.....	17.64 "	19.2 "	16.9 "
Wheel base: driv.	8 ft. 10.3 ins.	8 ft. 10.3 ins.	.....
" truck	.....	6 ft. 6.7 ins.	.....
" total.	15 ft. 6½ ins.	14 ft. 3.7 ins	14 ft. 7 ins.
W't on truck or leading whls. lbs	26,768	{20,160 / 21,280}	.....
Wt. driv whls. lbs.	86,016	83,152	.....
Wt. trail whls..lbs.	30,016	22,4 0	.....
W't, total	86,800	107,072	86,240
Tank, U. S. galls	.....	.....	1,000
Coal... .....lbs.	.....	.....	2,240

Rolling Stock.—One of the passenger cars of this road is shown in Fig. 5, and is fairly representative of French railway cars. The second-class cars have cushioned seats and backs, sliding sashes to all the windows, bare floor, roof painted white, and net racks for hand baggage. They are upholstered in green and have green curtains to the windows. The sashes in the doors have roller blinds. In each partition are two triangular glass "peepholes," about 8 ins. wide, which can be opened, and are intended for communication or giving an alarm. In each compartment are pasted six labels of caution and instruction on various points. The lamps give a very

poor light, rendered worse by the bottom of the lamp globe being level with the ceiling of the car. There are sliding ventilators over the seat windows. Oil boxes are used. Westinghouse and vacuum brakes are used, some cars being fitted for both. The wheels are tapped at most important stations. The head and tail lights are large round lamps, with big lenses of red glass, protected by a triangular brass guard. The cars are painted black above the window sills. The lower part is blue for the first class, green for the second, and brown for the third class. Sleeping cars and dining cars, carried on trucks, are run on this line. They are owned by the Compagnie des Wagons Lits. Some of the freight cars are of iron.

E. E. R. T.

Aluminum.

Census Bulletin No. 79 treats of aluminum in the United States. After briefly touching upon the history of this metal and outlining the various processes employed, the report deals with the two processes that have been commercially successful in this country. The earlier of these, the Cowles process, was established in 1885, and is carried on by the Cowles Electric Smelting & Aluminum Works, at Lockport, N. Y. This company is now confining its operations to the production of aluminum alloys, or aluminum bronze and ferro aluminum.

Their process consists in passing the current from a powerful dynamo through a mixture of alumina (obtained from corundum, bauxite, etc.), carbon and pieces of copper contained in a suitable vessel lined with carbon, through the ends of which vessel the large terminals of the dynamo are inserted. The alumina is reduced in the presence of the carbon and unites with the melted copper in an alloy rich in aluminum. This alloy is remelted and enough copper added to give the percentage required. The production of aluminum bronze by this company is given as follows:

1885	4,000 to 5,000 lbs.,	valued at	$1,600 to $2,000
1886	50,000 lbs.,	" "	20,000
1887	144,764 lbs.,	" "	57,000

In ferro-aluminum, made by the same company, iron is substituted for copper, the alloy containing from 5% to 10% of aluminum. It increases the tensile strength and the solidity of the iron. In 1886 the company made from 2,000 to 3,000 lbs. of this iron alloy, valued at $780 to $1,170. In 1887 they made 42,617 lbs., valued at $16,621. The total aluminum alloys produced in 1889 amounted to 171,759 lbs.

The Pittsburg Reduction Company, of Pittsburg, Pa., working under the patents of C. M. Hall, extracts pure aluminum. This process consists in forming a fused bath of the fluorides of aluminum, calcium and sodium (to which calcium chloride is subsequently added) by melting a mixture of cryolite, aluminum fluoride and fluor spar in a carbon-lined vessel. Alumina is added and the aluminum is separated by the current from a dynamo, the carbon electrodes of which dip into the bath. The process is continuous, as the alumina is renewed. The aluminum being of greatest specific gravity, sinks to the bottom of the vessel. If alloys are wanted the negative electrode is formed of the metal it is desired to alloy. This company produced 19,200 lbs. of aluminum in 1889, and it was sold at $2 per pound. Including that used in alloys the total production of aluminum in the United States in 1889 was 47,468 lbs., valued at $97,335. The import of aluminum into the United States in 1889 amounted to 998 lbs., valued at $6,688.07. The largest importation was 1,348 lbs. in 1888, valued at $14,086.

At the Paris Exhibition of 1855 aluminum was first exhibited in any quantity, but the price was then $181.81 per pound. In 1878 this metal was still somewhat of a curiosity, though it was exhibited that year as blocks, wire, in sheets, etc. In 1888 France produced about 6,500 lbs. of aluminum, valued at $50,100, or about $9 per pound. England made 12,000 lbs in 1889, valued at £6,000, or about $2.45 per pound at the average market price in London. The total English production up to 1890 is given as 42,000 lbs., or 21 tons. The Aluminium and Magnesium Fabrik, at Hemelingen, in Germany, near Bremen, has been in operation since 1887, and supplies all the aluminum used in Germany. In 1889 they made 20,000 lbs., and the total production for the three years 1887-89 was 43,120 lbs. The total production for America, France, England and Germany is then 116 short tons for the period 1860–1889. This is exclusive of 94 short tons of alloys. These figures will probably be interesting, for their slight dimensions, in a few years from now.

Though given before, more than once, in this journal, we briefly repeat here the statement of the physical qualities of this new metal, as taken from various late authorities:

	Tensile strength per sq. in.
Aluminum, 95.96%; silicon, 0.59; iron, 1.79% (Kemp)	18,866 lbs.
Aluminum, 95.70; silicon, 1.62; iron, 2.88 (Kemp)	17,425 "
Aluminum, proportions not given (W. H. Barlow)	26,800 "
Aluminum, Deville-Castner process (Richards')	25,000 to 30,000 "

Professor Thurston, in his "Materials of Construction," compares aluminum with other metals as follows:

	Specific gravity.	Wht. per cu. ft. lbs.
Aluminum, cast	2.560	160
" sheet	2.670	167
Bronze, ordinary	8.100	524
Copper, bolts	8.850	584
" cast	8.600	537
" sheets	8 880	549
" wire	8.880	550
Iron, cast	6.955 to 7.295	435 to 456
" " average	7 125	445
" wrought, average	7.680	480
Steel, hard	7.820	496

The tensile strength and other properties of the Cowles aluminum bronze and brass are shown in the following table, taken from the official report of tests made under the direction of the Engineer in Chief of the Navy at Watertown, New York:

Tests Made on Specimens of Aluminum Bronze and Brass.

Mark or number.	Approximate composition.	Length between reference marks.	Diameter.	Area.	Tensile strength per sq. in.	Elastic limit per sq. in.	Elongation in 15 ins.	Reduction of area.	Diameter at fracture.	Hardness. Head.	Hardness. Stem.
		Ins.	In.	Sq. in	Lbs.	Lbs.	%	%	In.		
1 C	Cu 91.5, Al 7.75, Si 0.75	15	1.875	2.7612	64,700	18,000	23.20	30.70	a1.56	9.39	13.85
7 C	Cu 88.66, Al 10, Si 1.33	15	1.875	2.7612	66,000	27,000	8.80	7.80	a1.80	14.12	14.25
9 C	Cu 91.5, Al 7.75, Si 0.75	15	1.875	2.7612	67,60.	24,000	13.00	21.62	a1.66	11.18	13.59
10 C	Cu 90, Al 9, Si 1	15	1.875	2.7612	72,830	33,000.	2.40	5.78	a1.52	.....	.....
11 C	Cu 63, Zn 33.33, Al 3⅓, Si 0.33	15	1.875	2.7612	82,200	60 73,000	2.37	9.86	a1.78	14.69	10.60
13 C	Cu 92, Al 7.5, Si 0.5	15	1.875	2.7612	59,100	19,000	15 10	3 502	a1.64	.....	.....
J D	Cu 91.5, Al 7.75, Si 0.75	15	1.930	2.8400	55,000	19,000	6.20	15.50	b1.75	.....	.....
10 D	Cu 90, Al 9, Si 1	15	1.850	2.8100	69,950	33,000	1.33	3.30	b1.86	.....	.....
11 D	Cu 63, Zn 33.33, Al 3.33, Si 0.33	15	1.9 0	2.8400	70 400.	55,000	0.40	4.33	b1.86	.....	.....
13 D	Cu 92, Al 7.5, Si 0.5	15	1.930	2.9300	46,550	17,000	7.80	19 19	b1.73	.....	.....

a Chill castings. *b* Dry sand castings.

For comparison with the tensile strength given above it can be said that Professor Thurston gives the highest figures, 52,928 lbs. per sq. in., to a brass made of copper, 79.65%; zinc, 20.35%. Copper itself has a tensile strength of 55,104 lbs. Bronze, made of copper, 90.27%, and tin, 3.73%, has a strength of 42,692 lbs. per sq. in. Steel containing 0.53% of carbon has a tensile strength of 79,062 lbs.; while another specimen noted, with 1.09% carbon, had a tensile strength of 116,394 lbs. The tensile strength of good cast pig iron ranges up to 20,000 lbs., of tough cast iron up to 25,000 lbs., and hard cast iron reaches 30,000 lbs. per sq. in.

The principal sources of aluminum have been hitherto cryolite from Greenland and imported bauxite. The Pennsylvania Salt Manufacturing Co. is working the Greenland mine and imports several thousand tons annually. The mine is 450 × 150 ft. in area and 100 ft. deep, and the drills show cryolite for at least 140 feet deep. Bauxite is now found in several places in Floyd Co., Ga., which carries from 52 to 57.25% of alumina, with 1.50 to 13.50% of iron oxide, about 2 % of silica and 3.5% of titanic acid. More recently still bauxide has been discovered in Saline and Pulaski Counties, Ark. This mineral carries about 57% alumina, 10% of silica and 2 to 6% of iron oxide. In both localities there is considerable water in the mineral. Kaolin, found in Pike and Pulaski counties, Ark., and in Pennsylvania, also contains from 36 to 38½% of alumina, with 46 to 49% of silica. Alum from extensive beds in Colorado contains about 15% of alumina.

The Spelling of Geographic Names.

In the second bulletin issued by the U. S. Board on Geographic Names, the principles are given which have been adopted for the official form or rendering of these geographical names. These rules are so useful and generally interesting, at a time when the utmost confusion prevails among nations in this direction, that we give them and the accompanying table in full.

Within the United States.—1. That spelling and pronunciation which is sanctioned by local usage should in general be adopted.

2. Where names have been changed or corrupted, and such changes or corruptions have become established by local usage, it is not in general advisable to attempt to restore the original form.

3. In cases where what was evidently originally the same word appears with various spellings, sanctioned by local usage, when applied to different features, these various spellings should be regarded as in effect different names, and, as a rule, it is inadvisable to attempt to produce uniformity.

4. Where a choice is offered between two or more names for the same place or locality, all sanctioned by local usage, that which is most appropriate and euphonious should be adopted.

5. The possessive form should be avoided whenever it can be done without destroying the euphony of the name or changing its descriptive application.

In Foreign Countries.—6. Geographic names in countries that use the Roman characters should be rendered in the form adopted by the country having jurisdiction, except when there are English equivalents already fixed by usage. In cases where the English equivalent is so different from the national form that the identity of the latter with the former might not be recognized, both forms may be given.

7. The spelling of geographic names that require transliteration into Roman characters should represent the principal sounds of the word as pronounced in the native tongue, in accordance with the sounds of the letters in the following system:

An approximation only to the true sound is aimed at in this system. The vowels are to be pronounced as in Italian and on the continent of Europe generally, and the consonants as in English.

Letters.	Sounds.	Example.
a	ah, as in father	Java, Banána, Somáli, Bari.
e	eh, e as in men	Tel el Kebir, Oléieh, Medina, Levuka, Peru.
i	English e; i as in ravine; the sound of ee in beet. Thus, not Feejee, but	Fiji, Hindi.
o	o as in mote.	
u	double o, as in boot.	
	All vowels are shortened in sound by doubling the following consonant.	Yarra, Tanna, Jidda, Bonni.
	Doubling of a vowel is only necessary where there is a distinct repetition of the single sound	Nuulua.
ai	English i as in ice	Shanghai,
an	ow as in how. Thus, not Foochow, but	Fuchau,
ao	is slightly different from above	Nanao.
ei	is the sound of the two Italian vowels, but is frequently slurred over, when it is scarcely to be distinguished from ey in the English they	Beirût, Beilól.
b	English b.	
c	is always soft and nearly the sound of s; the hard c is given by k	Celebes.

ch	is always soft, as in church	Chingchin.
d	English d.	
f	English f; ph should not be used for the sound of f. Thus, not Haiphong, but	Haifong, Nafa.
g	is always hard (soft g is given by j).	Galápagos.
h	is always pronounced when inserted.	
j	English j. Dj should never be put for this sound	Japan, Jinchuen.
k	English k. It should always be put for the hard c. Thus, not Corea, but	Korea.
kh	the Oriental guttural	Khan.
gh	is another guttural, as in the Turkish	Dagh, Ghazi.
l, m, n	as in English.	
ng	has two slightly different sounds as in finger, singer.	
p	as in English.	
q	should never be employed; qu is given by kw	Kwangtung,
r, s, t, v, w, x	as in English	Sawákin.
y	is always a consonant, as in yard (Kikuyu), and therefore should not be used for the vowel i. Thus, not Mikindány, but	Mikindáni.
z	English z	Zulu.
	Accents should not generally be used, but where there is a very decided, emphatic syllable or stress which affects the sound of the word it should be marked by an acute accent	Tongatábu, Galápagos, Paláwan, Saráwak.

Repairing the Kidderpore Dock Walls, India.

The walls of the Kidderpore docks, in India, failed by bulging in October, 1890, during the operation of excavating the center portion and before water was let into the dock. The last issue of *Indian Engineering* now summarizes the various reports of the engineers upon this accident, and illustrates the plans adopted for repair. From these reports we obtain the following information:

From the report of Mr. APJOHN, the engineer, we find that it was noticed, on Oct. 7, that the east wall was slightly bowed; and by the next morning the wall was 5 ft. 10 ins. out of line, the movement extending over a length of 1,400 ft. The wall was originally built with a batter of ½ in. per foot vertical, and it was 36 ft. high. In the worst place the thrust of the backing had actually pushed the wall 4 ft. 4 ins. over the ground. By the morning of Oct. 9, a length of 450 ft. had been moved 10 ft. out in the center; and it after that ceased to move

At the time of the failure the center of the dock had been excavated to almost the full depth; but a berm had been left against the walls 16 ft. above bed level, which was afterwards to be dredged, and this had been supposed to be sufficient to prevent movement. Preparations were at once made to fill the dock, after the accident, and to thus check any further bulging.

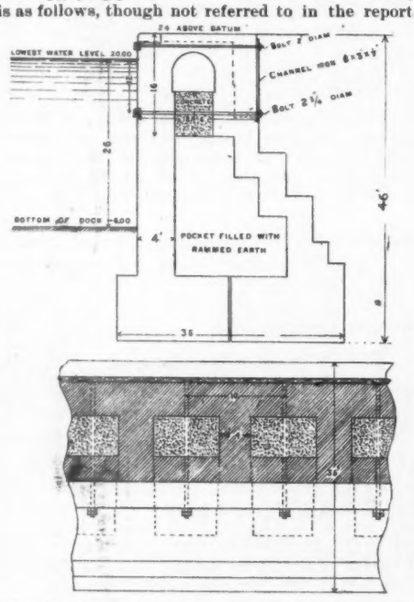
In the reports of Maj. A. S. MCARTHUR, R. E., and Mr. W. CONNAN, C. E., of Nov. 8, 1890, it is further shown that the movement extended in all over a length of 2,050 ft. in the straight east wall of the dock, commencing about 50 ft. from the north end and extending to an angle in the south end. The displacement at the extremities is shown by slight cracks in the face of the wall, extending through, and by longitudinal cracks along the course of the tunnel arch. The wall was forced forward by the earth backing and tilted so as to bring the face almost vertical along the whole damaged length. The maximum movement in the first case noted was at a point 1,700 ft. from the south angle, where the coping was displaced about 11 ft. The earth backing had sunk about 6 ft. for a distance of 75 to 120 ft. back from the face of the wall, filling completely the gap caused by the displacement of the wall. The wall itself had sunk through an average depth of 15 ins. over the injured portion. The masonry in the 450 ft. covering the worst movement, of 11 ft., was much shaken, and no less than seven cracks extended through the wall.

The next report is dated in March, 1891, and says that to that time no further movement had taken place. Water had been let into the dock on Oct. 14, 1890, and had been standing to a height of 11 ft. below the coping all this time. The committee appointed by the government to consider the engineering features of the original plans reported that they were satisfied with the weights of earth and brick work used, but they wish to record "that the coefficient of one-third, assumed by the engineer for the friction of the wall on its bed, must be considered doubtful, and that consequently there may be but a small margin between the opposing forces acting on it."

The committee adopted the proposition to fix the minimum water level in the dock at 20 ft., as it was of "vital importance to afford every possible support to the walls." They hold that the movement resulted in splitting the wall into two halves longitudinally for its whole length. To prevent any further separation they recommend that the earth filling be taken out of the pockets to a depth of 6 ft. below coping level, and that this space be filled by good hydraulic lime concrete. Bolts are to be passed through this concrete, as shown on Fig. 1, and a "greenheart" waling piece be imbedded in the wall below and a teak-wood waling piece above.

The committee assented to the plan of the engineer to corbel out to a straight line a part of the damaged portion of the wall. They also recommend that material as light as possible be used for the back-filling. The plan given is the one shown in the expert committee's report.

The lesson to be learned from this report and the accompanying plan, which is not an uncommon one, is as follows, though not referred to in the report



Cross-Section and Sectional Plan of East Wall of Kidderpore Dock, India.

quoted: As we understand the plan, a facing-wall of brickwork, 4 ft. thick and 40 ft. high, was braced by buttresses, 3 ft. 4 ins. thick, 10 ft. apart. The top of the pier was arched over as shown, and apparently longitudinal arches between the buttresses carried the masonry in that direction. The pockets between the buttresses were filled with rammed earth and the whole then back-filled with earth.

The weak point appears to be that while a wall so constructed would doubtless have withstood the water-pressure, from the inside of the dock, it was not well calculated to resist the thrust of the backing. In the first case the buttresses come into play under compression, and the 10 ft. of face-wall is thick enough to act as a beam over the pockets. In the second case, of pressure from the back, the face-wall had practically no resisting value in itself, and the 3 ft. 4 in. connection between the face and the buttresses was subjected to a tensile strain, under which it failed. The rammed earth had no value, except in its weight and the slight friction existing between it and the brick work. There was not weight enough in the wall to resist overturning; and its design concentrated a strain upon a point not calculated to resist this strain. If brickwork were more costly, it would have been better to have filled the pockets with concrete to begin with; and even then there would have been a certain lack of homogeneity in the wall, between the brick and the concrete. The data is not available for criticising too minutely the plan of repairs adopted; but it looks as if the bolts alone were being depended upon to tie this crippled wall together, though these are aided by the additional weight of the comparatively small concrete cap. The caution to fix the minimum water level at 20 ft. in the dock is wise.

Limestone in the United States.

The production of limestone in the United States for 1889 was as follows, says Census Bulletin No. 78:

	Quantity.	Value.
Building purposes	92,289,893 cu. ft.	$5,405,571
Converted into lime	18,474,658 bbls.	8,217,015
Stone for lime burning	478,082 tons.	184,024
Flux for furnaces	3,894,337 "	1,560,3 2
For street work	46,491,322 cu. ft.	2,383,456
Bridge, dam and railway work	26,679,012 "	1,289,622
Miscellaneous uses	549,875 "	46,079
Total value		$19,095,179

The expenditures were as follows:

Wages	$10,121,985
Supplies and materials	4,227,246
Other quarry expenses	743,483
Total expenses	$15,092,714

The capital invested in the industry amounted to $27,022,325; and of this sum $14,771,200 was in land; $4,988,207 in buildings and fixtures; $4,541,623 in tools, implements, etc., and $3,721,295 in cash.

Divided by groups of states the total value of output stands as follows:

North Atlantic	$6,491,834
South Atlantic	464,171
North Central	10,185,203
South Central	937,351
Western	1,016,620
Total	$19,095,179

The most productive states of the North Central division are Illinois, Indiana, Missouri and Ohio, in the order named. Three of these states produce more than $1,000,000 each, and the value of the output of Illinois is over $2,000,000. In the North Atlantic group Pennsylvania produces over $2,500,000 worth of limestone, and New York and Maine more than $1,500,000 each.

Legal Decisions of Interest to Engineers.

Interference with Public Contract by Injunction.—A judgment, in an action by the owners of property assessed for street improvements, restraining the city officers from paying out any money in pursuance of the contract for the improvements, which provides that the contractor should be paid semi-monthly as the work progressed, at the discretion of the city council, on the estimate of the city engineer, cannot be sustained where the only finding as to wrongdoing by the city officers is that the engineer improperly recommended payment; but there is no finding that the council had adopted the recommendation, or were about to do so, or that the officers charged with drawing the warrants had or were threatening to do any improper act. (Union Cemetery Ass'n v. City of Buffalo, Ct. App. of N. Y., 26 N. E. Rep., 310.)

Powers of Commissioners under Statute.—Where a statute authorizes two adjacent cities to construct a bridge and avenue across a river, between certain points in each city, and providing that the location shall be determined by the city councils of the cities, "acting separately," under a section providing that "the avenue may cross at grade any railway operated by steam, and the board of railroad commissioners shall, upon the application of either city, or any railway corporation, prescribe the details of the crossing," the cities have authority to lay out a crossing at grade, and one of the cities having laid out such a crossing, the railway commissioners have no power under the clause authorizing them to "prescribe the details," to order an over-head crossing. (City of Cambridge v. Railroad Commissioners, Sup. Jud. Ct. of Mass., 26 N. E. Rec., 841.)

Diversion of Water from Mill.—In an action for the obstruction and diversion of a stream, it appeared that a dam was built above plaintiff's mill, and a three-inch pipe inserted, through which the water ran to a tank. Plaintiff introduced evidence that since the dam was constructed there was never enough water to furnish full power to his mill, while before there had been enough to run it 10 months out of the year, and that before the loss of water the rental value of the mill was $500 a year, and afterwards nothing. Defendant introduced evidence that the diminution of the stream was not due to defendant's dam and pipe, but to a general drying up, and that plaintiff was not injured. The question was properly submitted to the jury, and a verdict for plaintiff would not be disturbed, as they are the sole judges of the facts. (Marsh v. Delaware, L. & W. Ry. Co., Sup. Ct. of N. Y., 12 N. Y. Supp., 376.)

Levy of Paving Assessment.—Where the statute authorizes the city government "to assess two-thirds of the cost . . . on the real estate abutting on each side of the street or lane improved," and requires "the frontage" of intersecting street or lanes to be assessed as real estate abutting on the street improved, the assessment may be apportioned among the several property owners by frontage alone, without reference to the depth, superficial area, or estimated value of the various parcels of abutting property. The statute requiring the frontage of intersecting streets and lanes to be assessed as real estate, and that the mayor and aldermen shall be treated as owners, and pay from the city treasury the just *pro rata* of cost for and according to said frontage, the cost of improving is not to be dealt with separately, paid by the city and deducted from the total cost, but is to be included in such total cost when the apportionment is made among the various property owners; and the city is to be charged, just as any other owner, with its *pro rata* share of the total cost, according to frontage. (Bacon v. Savannah, Supr. Ct. Ga., 12 S. E. Rep., 580.)

The Purification of Sewage.*

The exceedingly thorough manner in which the Massachusetts State Board of Health is carrying out its investigations into water supply and sewage treatment places their reports among the most valuable of all contributions to our knowledge on this subject. In many respects they surpass previous effort in the minuteness of their information and the exceeding care with which the experiments have been conducted. Owing to the importance of the matter and the space required to do any justice to its contents, we have made this report an exception to our usual rules of review, and publish such an abstract as its 910 pages make possible.

Mr. HIRAM F. MILLS, A. M. C. E., and a member of the board, contributes the first paper, covering 670 pages of this volume, on the filtration of sewage and water, and gives an exhaustive statement of the apparatus, experiments and results of the last two years' investigation at the experimental station at Lawrence, Mass. The character of these experiments forbids any attempt at giving more than a brief resume of purpose and conclusions. The first statement made is that American sewage is much more diluted than that found in European cities; and in every 1,000 parts of a sewage stronger than ordinary 998 parts are pure water, one part is mineral matter and one part animal or vegetable matter, classed together as organic. As the mineral component is not generally objectionable, sewage can be called "purified" if the one part of organic matter is removed. Of the two parts of mineral and organic matter, about one-half is in suspension, and can be strained out by the finest strainer that water will pass through. The other part is dissolved in the water and cannot be strained out and must be removed by some other means.

In discussing filtration, the "continuous" process is shown to be ineffective because the sand grows more and more filthy until the effluent is as impure as the sewage that is applied. In other words, to remove these organic impurities they must be oxidized, or burned; and under the above conditions no burning can go on within the sand because no air is present to support combustion. The process of purification by "intermittent filtration" is, on the other hand, an oxidizing or burning process, as will be seen from the following description of its action: To the surface of a body of open sand apply to-day one inch in depth of sewage, and to-morrow apply another inch, and on the following day a like quantity. By investigation it is found that the first inch shortly settles below the surface and the bottom particles go down about 9 ins., while the top particles remain just below the surface. In this 9 ins., about two-thirds of the space is occupied by sand, one-ninth by water and about one-quarter is air. The sewage is suspended here in extremely thin layers, covering over particles of sand and bridging over the space between other sand grains, and it is intimately mingled with more than twice its volume of air. In applying another inch of sewage the sewage of yesterday and most of the air in it is pushed down, with more or less admixture of the incoming sewage to the 9 ins. next below. This continues with each addition of sewage until the same quantity of water is pushed down through each sand layer, and the same amount goes out at the bottom. Fresh air is brought into the upper 9 ins. with each dose of sewage; and if the open sand bed is 5 ft. deep to the under drains, the sewage applied on any one day will be slowly moving for a week in very thin laminæ over particles of sand and intermingled with twice its volume of air. These conditions are found to be favorable for burning out the organic matter, and only a mineral residue is left in otherwise nearly pure water.

While this is called an oxidizing or burning process, Mr. MILLS points out that it is not the same as a rapid dry oxidation by heat. In the wet process nitrification occurs—that is, nitric acid is formed from the nitrogen of the organic matter and the oxygen of the air; and this strong acid at once combines with the potash, or soda, lime or other base in the sewage, and makes nitrate of potash, soda or other salt. But when this same liquid is evaporated, or the organic matter burned out by heat, no nitric acid is formed and no nitrification results. This nitrification takes the leading part in the purification process; and the conditions essential are the presence of oxygen, organic matter, moisture, some alkali and a temperature favorable for plant life. In other words, the experiments SCHLŒSING, MUNTZ and WARINGTON show that nitrification in a liquid never takes place but with the aid of organisms, introducing into the process organic life. Such organisms had been known to exist either in sewage or in the material of which some filters were composed, and when existing with the other conditions favorable for producing nitrification large quantities of organic matter could be converted into inorganic and mineral matter.

To give the proper relations of space occupied by sand, liquid and air, a coarse sand of quite even grain must be used. Sand of finer grain or mixed sand may permit a clogging of the filter bed, and fill all the space between the grains with water to the exclusion of air.

An interesting chapter now follows on the method of recording and the meaning of the results of analyses. Of this we can say here that the author points out that the purifying ability of a filter is indicated not only by the smallness of quantity of ammonia in the effluent, but by the greatness of the amount of nitrates. The excess of the latter shows the extent to which the nitrogenous organic matter of the sewage has been destroyed and its objectionable parts used to form unobjectionable mineral matter. An interesting record of the effect of frost upon a filter bed of 5 ft. of very coarse, clean mortar sand follows, and it is shown that in the four months of December to March, inclusive, 53% of all the nitrogen applied in the sewage was found in the nitrates in the effluent; while in the preceding four months only 33% of the applied nitrogen was so found. That is, during these cold months the nitrification was more complete than in the previous four hot months, and nearly reached the average of 61% for the preceding year. It was found that in the six months of May-October, of the second year, the average percentage of nitrates was 63, as against 41 for the corresponding six months of the previous year. This means that in a tank in constant use for nearly two years, without renewal of material or removal of surface sediment, nitrification was more complete in the second than in the first year. As showing the extent of the experiments made, it may be stated that the quantity of sewage passing through the filter in the four months previous to June 18, 1888, was at the rate of about 30,000 galls. per acre per day; after June 18, 1888, through October, 1889, the daily quantity averaged 58,000 galls. per acre per day.

In treating of bacteria in sewage, filtered through 5 ft. of very coarse sand, the report states that for one month previous to the application of sewage this tank was filtering city water at a rapid rate. The number of bacteria in a cubic centimeter of the applied water was 76, and in the effluent 24. After applying sewage containing from 500,000 to 1,500,000 bacteria in a cubic centimeter, the number in the effluent increased rapidly until at the end of 10 days the maximum of 387,000 was reached. In two weeks it fell to 1,443 bacteria per cubic centimeter. During this 10 days of rapid increase it is probable that the sewage was obstructed by frost in the tank, and that it was entering the lowest part of the filter by a few channels, and mingling more or less with water originally in the tank, containing some absorbed oxygen and some air. When this water was entirely removed, and the sand contained a liquid having so much organic matter that the oxygen that went into the tank with it was quickly reduced, the bacteria appear to have been unable to live during the passage through the sand. The general rule, however, was that on first applying sewage to a tank enormous quantities of bacteria came through, and then rapidly decreased in quantity as the sewage took full possession of the tank. Though the cold weather was at first charged with this phenomenon, it was found that the same occurred in the tanks housed over and not exposed to severe cold. After nitrification began the bacteria decreased from 3% to ⅛ of 1%. The greatest number of bacteria pass through the sand when sewage is applied after an intermission; thus, at the minimum rate of flow the number was 143, as the maximum rate was approached the number increased to 13,832, and in 1½ hours this gradually fell to 4,964. This maximum flow generally occurred one hour after the application of sewage to the tank.

The general conclusion as to management of filters is that with a coarse, open sand a less number of bacteria will live to get through if the under drains are deep and as far apart as possible. Also, that it is better, for this purpose, to apply 1 in. of sewage three times a day, than 3 ins. once a day. With these precautions the number of bacteria can probably be kept as low as 1 in 1,000 of the number applied, and possibly less. But it now appears that with this coarse sand we cannot depend upon as complete a removal of bacteria as with some layers of finer sand that will detain most of the forward particles of sewage 2 or 3 days within the sand.

In one of the tanks of coarse sand an aspirator was attached to the side cock 4 ft. below the surface of the filter, and 16 galls. per hour of air was drawn down through the sand. This aspirator ran night and day, renewed the air in the upper 4 ft. of the tank every hour. The result was a very marked increase in the nitrates in two days, from 0.0100 parts to 1.2000 parts, and in the next week to 2.3000 parts. The free ammonia did not change so rapidly. In one week it fell from 1.4300 parts to 0.0680 parts, and in the same time the albuminoid ammonia decreased from 0.0620 to 0.0750 parts. Fifteen days after this experiment was commenced the aspirator was disconnected, and in 11 days the nitrates decreased from 1.8000 to 0 0150 parts; the free ammonia increased from 0.0720 to 0.7840 parts, and the albuminoid ammonia from 0.0290 to 0.0960 parts.

Space forbids our entering more fully into the detail of each separate tank experiment, here given in full, with voluminous tables, diagrams of results, and their deductions. Each filter tank had its special mixture and disposal of sand, very coarse or fine, mixed with gravel or without, covered with earth or with peat, etc. But the final conclusions are given below:

In a general view of the results of filtering sewage intermittently through clean gravel stones, larger than robins' eggs, through filters of various grades of sand and gravel, down to sand with particles averaging 0.004 in. diameter, through soil and through peat, the following conclusions are reached:

In all sand and gravel, from the coarsest to the finest, purification by nitrification takes place, provided that the quantity of sewage is adapted to their ability, and the surface is not allowed to become clogged by organic matter to the exclusion of the air. Fine sand soils, containing 2 to 3% of alumina and oxide of iron and manganese, and 6 to 7% of organic matter, retain water so long, even in 6-in. beds, that the quantity of sewage that can be applied is small and the interval between applications is long. With a depth of 5 ft. of such soil nitrification will not take place, even with only 5,000 galls. of sewage per acre. Peat, to the depth of 1 ft. on the surface of a filtration area, will retain a liquid until it evaporates, and with it intermittent filtration is impracticable. Gravel is one of the best of all materials. In it, the slow movement of the liquid in thin films over large surfaces, with air in contact, caused the removal, for some months, of 97% of the organic nitrogenous matter, a large part of which was in solution, as well as 99% of the bacteria in suspension. There was only 3% of the decomposable organic matter of the sewage in the effluent.

The mechanical straining of sewage through sand is but an incident; the essential conditions are the very slow movement of the sewage in thin films over the surface of particles having spaces between them sufficient to allow air to be continually in contact with the liquid. With these conditions it is essential that certain bacteria should aid in the process of nitrification as before stated and these special bacteria appear in the sewage at all times of the year. This nitrification was found to be highest in all the filters in the growing months of May and June.

For reasons before stated some time must elapse after applying sewage to a filter before it commences to perform its proper functions. The following table shows the degree of purification attained for a month after the purifying condition was reached. The degree is expressed by the percentages which the sum of ammonias of the effluent bore to the sum of ammonias in the sewage, and the

* An abstract of Part II. of the Report of the Massachusetts State Board of Health, on Water Supply and Sewerage, Boston, 1890.

percentage which bacteria in the effluent bore to the number in the sewage:

No. of filter.	Quantity of sewage in galls. per acre per day.	% of ammonias of effluent to sewage.	% of number of bacteria in effluent to those in sewage.
14	120,000	1.0	3.0
13	60,000	0.7	0.005
1	43,000	0.9	0.3
12	28,000	0.8	0.15
6	45,000	0.7	0.02
11	30,000	0.6	1.0
2	19,000	0.3	0.01
4	14,000	0.8	0.0.1
7	11,000	0.3	0.001

NOTE.—Filter tanks Nos. 1, 12, 13, 14 were filled with 5 ft. of very coarse, even sand. Tank No. 2 had 5 ft. of very fine, nearly white sand. Tank No. 4 had 5 ft. of river silt, mostly of very fine sand. Tank No. 6 had 3 ft. 8 ins. of coarse and fine sand and fine gravel. Tank No. 7 had 3 ft. 8 ins. of the same as No. 6, covered by 10 ins. of yellow sandy loam and 6 ins. of brown soil. No. 11 tank was the same as No. 6, but with a diameter of only 20 ins. Tanks 12, 13 and 14 had this same diameter of 20 ins. All the other tanks mentioned were 16 ft. 8 ins. in diameter, giving a surface area of 100 times that in the smaller tanks. All of the tanks, large and small had at the bottom a layer of coarse gravel (1 to 2 ins. diameter), followed by finer gravel down to ¼ in. diameter, making in all a stratum 3½ ins. thick. Above this was 3½ ins. of very coarse mortar sand; and above this substratum of 7 ins., which was common to all the tanks, came the various materials noted.

At the time of this experiment all the sand filters were burning up the nitrogenous impurities and thus removing from 99 to 99.7% thereof. The number of bacteria in a cubic centimeter of sewage was from 340,000 to 1,400,000. The number of bacteria found in the effluent averaged for these months from 3% in the open sand filter passing the greatest quantity of sewage to 0.001% in the finest sand and the sand covered with soil. The filter No. 14 required from one and a half to seven days for the sewage to pass through its 5 ft. depth; the finer filters, Nos. 2, 4 and 7, required from 3 to 5 weeks for the water to pass through them. The first allowed more bacteria to pass than are found in good drinking water; the latter less than are found in such water. Most of these filters had been filtering for from one year to one and a half years before they reached the established condition of purification as here tested. As a general statement, it is found that bacteria decrease with the completeness of the nitrification, and independently of the sum of the ammonias and the albuminoid ammonias.

These experiments show that while the chlorine and nitrates found in the effluent are higher than in public drinking water, they are principally common salt and saltpetre, and in the quantity found are entirely harmless. But even supposing the ammonia to be eliminated, disease-producing bacteria may pass through, especially in coarse filters, and though few in number they may increase in the human body. For these reasons the board cannot assume that the effluent from the coarse filter is suitable for drinking water. An examination of 10 wells in Lawrence, however, showed that in each case this drinking water was, in fact, sewage-contaminated water, not so well purified as the effluent from the filters with which each was compared.

In connection with these sewage experiments the rainfall and evaporation has been also observed for 1888-'89-'90. A tank 17 ft. 4 in. in diameter and 6 ft. deep was used, with the surface of the water kept within 1.25 ft. and generally 0.5 ft. from the top. The results are given for each month in these three years; but the following table shows the annual averages only:

All in inches.	1888.	1889.	1890.	Mean for 3 years.
Rainfall	55.11	47.64	52.43	51.73
Evaporation	34.59	21.47	25.41	29.16
Evaporation in per cent. of rainfall	63	58	48	56
Average daily evaporation	.09	.08	.07	.08
Average daily evaporation with no rainfall	.12	.10	.12	.11

The rainfall in each of these years was above the average, which has been for 24 years 44.21 ins. The mean yearly evaporation for the 3 years was 29.16 ins., while that for the 4 cold months of Dec.-March was 5.98 ins., or 6-10 as much as the average 4 months of the year. The highest daily evaporation was in June and July, 1888, and June, 1889, equal to 0.26 in. and in July, 1890, it was 0.30 in. The average daily evaporation on days when there was no rainfall was highest in the same months, and amounted to 0.18 in. in 1888, 0.19 in. in 1889, and 0.21 in. in 1890. In the same months the maximum weekly evaporation amounted to 1.5 ins. The greatest evaporation in one month was 5.2 ins., in July, 1888, and the least was 0.62 in., in March, 1890.

Messrs. THOMAS M. DROWN and ALLEN HAZEN, in this same report, treat of the chemical work done in connection with sewage purification. This portion relates generally to the methods of analyses used in arriving at the results already given. But in a separate chapter Mr. HAZEN reports on experiments made at Lawrence in the chemical precipitation of sewage. The substances best adapted and most commonly used for this purpose are lime and the salts of aluminum and iron. As to their cost, lime, with 70% available calcium oxide, costs about $9 per ton; ferrous sulphate, or copperas, containing 26% of ferrous oxide, costs $10 per ton; aluminum sulphate, or crude alum, with 14% of alumina, costs $25 per ton. A ferric salt can be made by oxidizing copperas with chlorine, or with sulphuric acid and nitrate of soda. The approximate cost of these oxides in solution is as follows:

Aluminum oxide	9 cts. per lb.
Ferric oxide	3 cts. per lb.
Ferrous oxide	2 cts. per lb.
Calcium oxide	⅔ ct. per lb.

In making the experiments 100 galls. daily of sewage was assumed for each inhabitant in calculating the annual cost.

The detailed report of the experiments follows, with diagrams showing results, but we must content ourselves here with the general conclusions. The amount of lime required by the Lawrence sewage averaged about 1,600 lbs. per million gallons. Ordinary house sewage is not sufficiently alkaline to precipitate copperas, and a small amount of lime must be added to obtain good results. The quantity of lime required can be calculated from titration of the sewage. After mixing the sewage with copperas and lime, if enough or too much lime is used the mixture will color phenolphthalein red; if too little, no color will be produced. With a sufficient quantity of lime, the more copperas used the better, but more than ⅓ ton per million gallons does not secure results proportionate to the increased cost.

In precipitation by ferric sulphate and crude alum the addition of lime was found unnecessary, as ordinary sewage contains enough alkali to dissolve these salts. Within reasonable limits the more of these salts used the better. Using equal values of the different precipitants, applied under the most favorable conditions for each and upon the same sewage, the best results were obtained with ferric sulphate. Nearly as good results were secured with copperas and lime used together, while lime and alum gave somewhat inferior effluents. When lime is used there is always so much lime left in solution that it is doubtful if its use would ever be found satisfactory, except in the case of acid sewage. It is impossible to obtain by chemical precipitation effluents which will compare in organic purity with those obtained by intermittent filtration through sand. It is possible to remove from one-half to two-thirds of the organic matter by precipitation, with a proper amount of an iron or aluminum salt. If the process is carried out with the same care as is required in intermittent filtration, the best that can be hoped for is a result which will effectually prevent a public nuisance. In these experiments the cost of chemicals per inhabitant per year is taken throughout at 10 cts.

One of the concluding reports in this volume is that of WILLIAM T. SEDGWICK, Ph. D., on the biological work done at Lawrence. This part details the methods employed and the results obtained in the microscopical and bacteriological examination of sewage and of water, and is illustrated by photographs of observed bacteria. While this chapter is valuable as giving the latest practice in this science, no mere abstract can do it justice or convey much useful information. The last report of all is that of EDWIN O. JORDAN and ELLEN H. RICHARDS on investigations upon nitrification and the nitrifying organism. The result may be briefly stated as follows: The organic matter in suspension decays in about seven days, as is shown by the increase in "free ammonia." In about 14 days this "free ammonia" has disappeared, and nitrite has taken its place, reaching a maximum in 21 days. Later the nitrite, too, disappears, and in 28 days or more a the nitrogen has been converted into nitrate. When the suspended matter is removed by filtration through paper, or by precipitation with alumina, no change occurs unless free ammonia were present at the outset. In other words, nitrification is not the result of chemical action, but is due to the vital activity of bacteria, as pointed out by SCHWANN and SCHULTZE as early as 1839, and later and more conclusively by PASTEUR.

An English Cement-Testing Machine.

We find the accompanying illustration of a cement-testing machine in *The Engineer*. The construction and operation of the machine are apparent from the engraving. The briquette is placed in the clips and the right hand lever is pulled over, raising

Cement Testing Machine.

the left hand weighted arm and putting a strain on the briquette. The index pointer on the left-hand lever pushes forward a sliding clip along the graduated arc, so that the record of the tension at which the briquette broke is kept when the lever falls. The maker of the machine is Mr. V. DE MICHELE, of Westminster.

We do not understand that any claim is made to great accuracy for the machine, but it might be of use where a very large number of routine tests had to be rushed through and accuracy was not essential. We may add parenthetically that with some brands of American cement which we have seen tested, the lever would be pulled up high enough to give a pretty solid thump when it fell back.

The Iron Gates of the Danube.

The accompanying illustrations, for which we are indebted to the Ingersoll Rock Drill Co., are taken from photographs intended to show the general character of some of the work to be done there in mproving this famous waterway.

The importance of regulating the channel of the lower Danube was recognized by the Romans in the time of TRAJAN; and since that date, at wide intervals, the subject has been before the commercial and engineering authorities of the nations interested; Austro-Hungary chiefly, with Servia and Roumania also touching that part of the Danube at the "Iron Gates." Austrian, French, English and

American engineers have been consulted as to plans of improvement; and in 1870 the late WILLIAM J. MCALPINE, Hon. Mem. Am. Soc. C. E., submitted a scheme to the Austrian Government which is the acknowledged basis of the plans now being put

"THE IRON GATES" OF THE DANUBE.

into execution by M. BAROSS, the Hungarian Minister of Commerce.

The details of this plan have been worked out by the Hungarian engineer, WILLANDT. This includes a canal, about 1¼ miles long and 262 ft. wide, on the Servian bank; some shorter canals and much blasting of rocks from the river bed. The result aimed at is the uninterrupted traffic by steamers between the Black Sea and the cities of Pesth and Vienna.

The present work was formally inaugurated on Sept. 15, 1890, by Mr. BAROSS; and to him is said to belong the credit of deciding to do without obstructing locks in the canals as planned, whereby a saving of $35,000,000 is effected. The following quantities are given for the rock that has to be removed from the bed of the river:

	Cu. yds.
At Stenka	9,000
" Izlas Tachtalia	157,000
" Jucza	42,000
" The Iron Gate	320,000
Total	528,000

In addition to the above, 657,000 cu. yds. have to be excavated from the right bank of the Danube at Greben. It is estimated that the work can be completed by about the end of 1895. Rock drills on tripods, of the Saunders type, and mounted on barges, are being used in the river. The rocks which jut out on the Servian side for a distance of about 1,400 ft. cause a whirlpool with an estimated depth of over 150 ft. Directly below these rocks the river widens out into a veritable lake nearly 9,000 feet wide. At this point various improvements will have to be undertaken to regulate the stream, including a dam constructed with the excavated rock. The cost of the plant alone, to be used on this work, is estimated at $1,041,000.

A considerable part of the above description is taken from an abstract, in the Selected Papers of the Institution of Civil Engineers, of an article by J. J. VAN DEN WYNGAERT, the original of which is contained in the *Verhandlungen des Vereins zur Bejoerderung des Gewerbfleisses*, Feb., 1891. This original contains much detail of plant, and of the political and commercial importance of the work, that is omitted in the abstract. The photographs come to us unnamed as to exact locality. But the one is supposed to be the Iron Gates proper, and the other as showing the rocks jutting out from the Servian shore, above referred to.

THE RECTIFICATION OF THE DANUBE; ROCKS JUTTING OUT FROM THE SERVIAN SHORE.

Asphaltum in the United States.

In the year 1889, says Census Bulletin No. 75, the total amount of asphaltum produced in the United States was 51,735 short tons, valued at $171,537. Of this quantity the bituminous rock of California produced 47,998 tons, and Utah 3,163 tons; the remainder came from Kentucky (112 tons) and from the gilsonite of Utah (492 tons). This later is the purest yet found and contains 90% bitumen in the crude mineral. The California deposits of Ventura Co. are in a bituminous rock containing 24% of bitumen and about 64% of silica, with oxide of iron and calcium carbonate. The price ranges from $8 to $10 per ton. The bituminous rock of San Luis Obispo and Santa Cruz is valued at $2.50 per ton at the mines.

The greater part of the world's supply of asphaltum come from the island of Trinidad and the deposits of Seyssel, in France, and Val de Travers, in Switzerland. Cuba furnishes some excellent asphaltum, and large deposits are reported to exist in the State of Tabasco, Mexico, though little has been shipped from the latter point.

The ruling prices for the different varieties during the year 1889 were as follows:

Trinidad, crude, at New York	$13.00 per ton
Trinidad, refined, " "	3 .00 "
Hard Cuban, " "	28.00 "
Gilsonite, at the mines	60.00 "
Bituminous rock, California, at mines	2.50 to 10 00 "
Bituminous rock, Kentucky, "	2.40 "
Prime Cuban, at New York	4.5 to 5.5 per lb.

The importation of asphaltum into the United States may be said to have practically commenced in 1869, when 185 tons, worth $5,632, were brought in. This quantity steadily increased until, in 1889, 61,952 tons, worth $138,..63, were imported. Of this latter quantity 52,881 tons were Trinidad asphaltum. In 1880 only 3,913 tons came from this island. The imports of bituminous limestone from Neufchatel, Switzerland, and Seyssel, France, amount to about 200 tons annually; and about 150 tons of a similar material come from Hannover and Brunswick, in Germany. During 1887-90 about 6,000 tons of bituminous limestone were imported from Sicily and used in street paving. The number of square yards of Trinidad asphalt pavement laid in the United States is now 6,803,054. In 1880 there were 106,838 sq. yds. down, and in 1890 1,875,000 sq. yds. were laid. About 72% of all the Trinidad asphaltum imported is used for street paving, 24% is used in asphalt block and tiles for pavements, and 3% for roofing purposes.

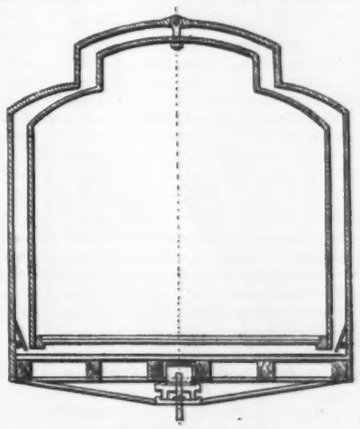
The total areas covered by bituminous limestone pavement in European cities is given as follows:

Berlin	681,486 sq. yds.
London	360,000 "
Paris	357,360 "
Other cities	300,000 "
Total	1,698,846 sq. yds.

This is equivalent to about one-fourth of the area covered by Trinidad pavement in the United States.

A Swinging Railway Car.

A decidedly novel idea in car construction has been patented by Mr. W. C. WHITNER, of Rock Hill, S. C. The accompanying sketch makes the scheme plain at a glance. The car is suspended from an outer encircling frame and is free to swing like a pendulum as the car runs over rough tracks or around curves. Spring buffers are provided on the sides of the outer frame to prevent the car bringing up with a shock in its swing; and we suspect that to avoid seasickness it would be well to make these buffers long enough to exert considerable pressure on the car body when hanging in mid-position. Were the car body entirely free to swing, the passengers might find the journey altogether too much like being "rocked in the cradle of the deep."



Swinging Railway Car.

The scheme is claimed to be particularly applicable to dining and sleeping cars, and it is not impossible that if properly arranged it might save a few cups of spilled coffee. We fear, however, that the inventor has not sufficiently considered the difficulties in and expense of his peculiar construction, as well as the disastrous consequences which would be apt to follow a moderately severe collision with the car body so free to move. As he informs us that a practical test is to be made, we trust an investigation of these points will not be omitted.

Life of Grip-faces and Cables on Cable Roads

The renewal of cables and the grip-faces, or dies, form heavy items of expense in the operation of cable roads, and any information concerning practical experience in these directions must be useful. In *The Technograph*, of the University of Illinois, Mr. F. W. RICHART has a short paper on this subject, which we give as follows:

Very little information could be obtained concerning the earlier forms of grips. Some of the earlier cable roads in San Francisco used the Paine grip, which had solid dies with a pair of carrying pulleys at each end, forced out beyond the dies by springs, and which carried the cable, preventing it from rubbing the dies when they were re

leased. The carrying pulleys are not usually used in more modern practice. Another form of grip designed to prevent wear of the cable consisted of two rectangular steel bars having rounded ends, each having a dovetail groove the entire circumference in the long direction. In these grooves short brass blocks were placed, so that when the grip is slackened the brass blocks slid round, taking the wear instead of the cable.

This was once used on the Brooklyn Bridge, but was unsatisfactory. The grip used on that bridge at present consists of small sheaves with grooves facing, which turn when the grip is slack, but on increasing the pressure the friction becomes sufficient to stop their turning and move the car. This grip has been used on cable roads with unsatisfactory results. The tendency is to lengthen the cable and diminish the diameter. All Kansas City lines use dies made of the Worrell alloy, which is made of cast-iron and another metal supposed to be copper. The endurance of the dies is two weeks on two lines, and is given by two authorities as two weeks and seven weeks on the third. The one who gives two weeks is probably the best authority. The Locust Street Line, of St. Louis, uses a phosphor bronze die, which gives satisfactory results, lasts as long as six weeks, and wears the cable less than soft (presumably cast) iron. The Chicago City Ry. Co. uses a grip die which lasts one month. The composition is copper 60 lbs., tin 10 lbs., zinc 13 oz., lead 18 oz.

Quite a number of roads have tried cast iron with unsatisfactory results. It can be used but a short time before renewal is necessary. A silicated iron has been used on one of the Chicago roads, lasting about five times as long as ordinary cast-iron.

Cast-steel is being used to a considerable extent at present, and with very satisfactory results. It lasts several times longer than any of the alloys or cast iron, and, according to Mr. Van Vleck, wears the cable but a trifle more. The Vogel Cable Construction Co. states that gripping dies are made of the hardest material possible, and when the expense is not too great of tool steel.

The conclusions to be drawn from the tables below are not numerous. We can see that cast iron does not last any considerable length of time. Some grades of cast steel are poor, but good grades give greater wear than any other material cited. Of alloys, phosphor bronze wears longest. The alloy used by the Chicago City Ry. Co. seems to give very good wear, but is evidently expensive. As to the life of cables as affected by different materials used in the dies, the average life of Kansas City cables from the table is 10.84 months with dies made of the Worrell alloy, while the Washington and Georgetown cable has not yet been renewed after eleven months use, with cast-steel dies. The only difference in the two cables is in the number of wires, the diameter being the same. The former has 96 and the latter 114 wires in six strands, with hemp core.

LIFE OF CABLES.

Street.	Length cable, feet.	Life cable.	Speed.	Character road.	Remarks.
Kansas City.					
E. 5th		6 mo.	7 to 9 miles per hour.	Very crooked	Metropolitan Line.
W. 5th		7 mo.			
E. 12th		12 mo.		15 p. c. grade	
W. 12th		7 mo.			
W. 18th	32,300	7 mo.			
E. 18th		18 mo.			
Westport	30,500	14 mo.	9 mls.		Grand Ave. Line.
Walnut	14,200	4 mo.	8 mls.	Very crooked	
15th	29,500	15 mo.	9 mls.		
Holmes	22,000	Has been in 22 mths.	9 mls.	10 p. c. grades	
Main Line		8 mo.	8 mls.	18.53 p. c. grade	K. C. Cable Line.
Washington		9 mo.	12 mls.		
Troost Ave.		12 mo.	9 mls.		
Washington.					
7th	33,000	On 11 mths.		Almost straight	*
Chicago.					
Chi. Cy. Ry. Co.		40,000 miles.			

* Business very heavy.

Steel Making in Australia.

Some time ago we reported the fact that the government of New South Wales had called for sealed proposals to be opened June 21, for the supply of 175,000 tons of steel rails, to be manufactured within the colony with the use of raw materials mined there and delivered during five years from Jan. 1, 1893. The total amount of steel in all forms imported by the Australian colonies is said to exceed $15,000,000 per annum in value. The only Australian colony which contains the raw materials necessary for steel making, so far as known, is New South Wales. It is with the desire of securing the establishment of works for the manufacture of steel in this colony that the government offers to guarantee to the builders of steel works orders for steel rails at the rate of 35,000 tons per annum, for five years. The last number of *The Engineer* gives the following account of the steps which Englishmen are taking to improve this chance for a profitable investment:

We learn that a syndicate is now being privately formed in this country with a view of thoroughly investigating and proving the deposits of minerals in New South Wales, which have already to some extent been examined and very favorably reported upon, and if it is found that the quantity and quality are satisfactory, then a definite company with limited liability will be formed for the purpose of opening out the mines and erecting furnaces and mills of the most modern and approved type for the manufacture of steel and iron for the supply of the colonies of Australasia and other available markets, including China, Japan, Straits Settlements, etc. Connected with this syndicate are Mr. J. C. CUNINGHAME, of Craigendr, N. B., and Mr JOHN CUNINGHAME, of Glasgow, the well-known Scotch ironmasters, and Mr. JOSEPH MITCHELL, a member of the New South Wales Legislature, is now over in this country with a view to advancing the formation of this syndicate and of bringing about the establishment of iron and steel works in the Colony.

The New South Wales Government have evinced their desire to encourage the industry by entering into negotiations with Mr. MITCHELL for the manufacture and supply, as an initial order, of the 175,000 tons of steel rails to be delivered at the site of manufacture over a period of five years from Jan. 1, 1893, at a price equal to the ruling price for the time being for British-made rails landed at Sydney. From what is already known as to the extent and quality of the deposits of iron ore, coal, etc., it is calculated that hematite pig iron suitable for conversion into steel can be made at 40s. ($9.72) per ton, and the cost of making steel rails is estimated at 90s. ($21.87) per ton; whereas the average cost of imported steel rails, delivered at Sydney over the past twelve years, has been £6 9s. 4d. ($31.50) per ton, or nearly £2 more.

Some of the iron ore has been analyzed by Mr. LEWIS COLQUHOUN, Ardeer Iron Works, Stevenston, Ayrshire, and was found to contain 55.77% of metallic iron and .043% of phosphorus as received, and 56.65% metallic iron and .044% phosphorus when dried; while Messrs. PATTINSON and STEAD, of Middlesbrough, report upon a sample from the outcrop at Picton, New South Wales, 56.76% metallic iron, 5.02% silica and 0.048% phosphorus, and state that even less phosphorus may be expected to be found in the ore under the surface. Mr. J. W. ORMISTON, of Glasgow, states that at one place—Ryiston—ample supplies of coal, ironstone, limestone, etc., are to be met with within a circle of two miles. Bearing in mind how some of the proprietors of Spanish mines have been deceived by finding the ore beds which they had purchased scarcely more than surface deposits of little thickness, the syndicate will by boring ascertain the thickness as well as the superficial extent of the ore seams. We are informed that Messrs. JOHN STEPHENSON & COWPER, of Queen's square, Middlesbrough, have charge of the formation of this syndicate and it is not improbable that Mr. STEVENSON, who has had great experience in similar matters in this country, will be required to go out to New South Wales, in order to organize and set in operation the contemplated works.

Diagram for the Application of the Law of Heating as it Affects Insulated Electrical Conductors.

BY THOS. J. FAY.

In the presentation of the diagram (see next page) to the electrical reader, a few remarks upon some of the most important points embraced will be appropriate. The object of the diagram is to obviate calculations as much as possible, when it is found necessary to determine the carrying capacity in amperes of an electrical conductor. A number of diagrams have been placed before the public for this purpose, but, so far as the writer is aware, all of them have been based on a given increase of temperature, while this diagram, it will be seen, can be used for the heating effect due to any increase in temperature over that of the surrounding atmosphere.

It will also be seen that this diagram contains a comparison of Fahrenheit, Centigrade and Réaumur degrees, which it is thought will not be out of place. However, as this scale is constructed to read "above the surrounding temperature," the proportion from F. degrees to C. degrees is as 212 : 100, and not as 212 — 32 : 100, which would be the case in calculating for difference in degrees under usual conditions. This rule also holds good in calculating for the difference between Fahrenheit degrees and Réaumur degrees under these circumstances.

In the scale for lamps three voltages are employed—*i.e.*, 55, 75 and 110. Assuming that each lamp consumes 55 watts, the column of 55-volt lamps may also be read as amperes, because a 55 volt lamp to consume 55 watts must carry one ampere. The 75-volt lamps are rated at a slight increase in consumption over 55 watts.

The lines representing the ratio between amperes or lamps and heating effect also represent the required size of the conductor in B. & S. gage, there being one line for each size from No. 0000 to No. 20. It is not considered advisable, however, to employ a wire smaller than No. 16 for lighting purposes, owing to the low tensile strength of the smaller wires.

In determining the ratio between amperes and heating effect, many practical as well as theoretical considerations were taken into account. In most diagrams, or tables for that matter, the ratios are based upon results obtained by using a bare, bright, round conductor, exposed to the atmosphere; as a matter of fact no such conditions are ever met in actual practice, while on the other hand we will often employ conductors covered with insulation which is also a non-conductor of heat (for that matter all insulators are to a very great extent), and then inclosed in an additional covering, such as molding. Under these and most ordinary conditions, tables based upon results obtained by using bare wire will prove erroneous to a very alarming extent.

An advantage is also gained by employing this diagram for the reason that one is not confined to a single temperature, which is usually the case, and in wiring in installations where different rooms are heated to different temperatures (such, for instance, as an engineroom and a refrigerator) due allowance may easily be made for such differences.

It will be well to remember that this diagram is only intended for use in proportioning conductors for cross section, as the resistance of a conductor, due to its length, follows a different law, and must be separately dealt with.

If used strictly for the specified purpose for which it is intended, this diagram will be found very useful in wire calculations in a large number of installations which are now either computed from formulas not applicable to the case or are merely roughly estimated.—*Electrical World.*

LIFE OF GRIP DIES OF VARIOUS MATERIALS.

ROAD.	MATERIAL.	LENGTH.	LIFE.	REMARKS.
Chicago		19 in.	144 miles	
N. Chicago	Cast iron	20 "	225 miles	
"	Silicated iron (special mixture).	19 "	700 miles	
"	Cast steel	19 "	368 miles	Not Chicago C. S. Co.'s make.
"	"	19 "	2,009 miles	Chicago Cru. S. Co.'s make.
"	"	20 "	2,250 miles	
Chicago City Ry.	Composition		One month	
Washington & Georgetown Ry.	Cast steel	15½ in.		Have not been removed after 4½ months' use.
Kansas City				Dies, two pieces each 7 ft. long.
Metropolitan	Worrell alloy	14 in.	Two weeks.	
Grand Avenue	"	16 "	Two weeks. 40 to 50 days.	Two authorities.
K. C. Cable	"			
St. Louis			15 days	
Locust St. Line	Phosphor bronze		6 weeks	Made by Congden Brake Shoe Co., Chicago.
Broadway Line			1 to 3 weeks	
Vogel Cable Con. Co.	Hardest possible	11⅛ 12		Length me'd from scale drawing.

PERSONALS.

Mr. C. S. EVANS has been appointed Assistant Superintendent of the Western & Atlantic R. R.

Mr. J. D. COOK, of Toledo, O., has been engaged as consulting engineer for the improvement of the west district water-works at Saginaw, Mich.

Mr. HARRY WALTERS, Vice-President and General Manager of the Atlantic Coast Line, has resigned the latter position, and Mr. J. R. KELLY has been appointed General Manager.

Mr. GEORGE W. STEVENS, General Superintendent of the Chesapeake & Ohio Ry., has been appointed General Manager. Mr. H. FRAZIER has been appointed Chief Engineer, with office at Richmond, Va.

Mr. FRANK L. NASON, late assistant geologist of the New Jersey Geological Survey, has been appointed to a similar position in the State Survey of Missouri. He is to especially examine and report upon the iron ore deposits of the State.

Mr. WALKER FEARN, of New Orleans, has been appointed Chief of the Foreign Department of the World's Columbian Exposition, in place of Mr. MELVILLE E. STONE, resigned. Mr. FEARN was connected with the legations of this country at Brussels, Mexico and Paris, and was U. S. Minister to Servia, Roumania and Greec

He was Special Commissioner-General abroad for the New Orleans Exposition.

THE U. S. ELECTRICAL COMMISSION for Washington, D. C., appointed last spring by the President to study the subway and conduit questions, is made up of ANDREW ROSEWATER, Prof. HENRY A. ROWLAND and Lieut. F. R. SHUNK, U. S. Engineers, as already noticed. The *Evening Star*, of Washington, D. C., lately gave sketches of these gentlemen, which may be condensed as follows:

Mr. ANDREW ROSEWATER was born Oct. 31, 1848, and was educated in the public schools of Cleveland. In April, 1864, he secured employment upon the engineer corps which was sent out to make surveys and explorations of the Rocky Mountains with a view of determining upon a practicable route for the Pacific Ry. In 1866 he staked out the first mile of track on the Union Pacific road, and soon after was appointed inspector of ties and bridge material of the road, with headquarters at Omaha. In the spring of 1867 he was assigned to duty in the engineer corps selected to make a special exploration and survey of the Rocky Mountain region in order to select the best possible crossing for the road. The party was much harassed by Indians, and the Chief Engineer, PERCY T. BROWN, was killed while trying to extricate his party from an ambuscade. Mr. ROSEWATER, with two others, was selected to prepare the maps, profiles and estimates of the 300 miles of line embraced in their surveys of the season. In 1868 Mr. ROSEWATER was appointed Assistant City Engineer of Omaha, and in 1869 he was promoted to the position of City Engineer, and continued in that position, excepting an interval of a few months, till the spring of 1874. He then engaged in journalistic work, serving at times both as business manager and editor of the Omaha *Bee*. In 1878 he resumed the engineering profession and was engaged for nearly two years as engineer in charge of construction of what is now a part of the Omaha, Minneapolis & St. Paul Railway. In 1880 he opened up a private engineering office at Omaha and was shortly after engaged as Resident Engineer in charge of construction of the Omaha water-works. In the following year he was tendered the position of City Engineer of Omaha, which he accepted. Under his administration the city was wonderfully improved. Mr. ROSEWATER resigned his position in 1887 to enter upon the larger field as Consulting Engineer of Municipal Public Works, making sewerage designing a specialty. He is a member of the American Society of Engineers and was the first President of the Nebraska Association of Engineers and Surveyors.

Prof. HENRY A. ROWLAND graduated from the Rensselaer Polytechnic Institute at Troy in 1870. He was first engaged in railway work, was then a teacher at Wooster University, and in 1872 he was instructer in physics and in 1874 assistant professor at the Rensselaer Polytechnic Institute. When Johns Hopkins University was founded he was made professor of physics and director of the physical laboratory, and he further studied this branch of science in Berlin with HELMHOLTZ. The degree of Ph. D. was conferred upon Prof ROWLAND by Johns Hopkins University in 1880. As a member of the electrical congress at Paris in 1881 and of the jury at the electrical exhibition at the same time and place he received the order of a chevalier of the Legion of Honor. In 1881 he was elected a member of the National Academy of Sciences. In 1883 he presided over the physics section of the American Association for the Advancement of Science at Minneapolis, and read a memorable address, entitled "A Plea for Pure Science." In 1884, being appointed by the Government on the commission specially formed for the purpose, he presided over the national conference of electricians at Philadelphia. During the same year he received from the American Academy of Arts and Sciences, of which he is an associate, the Rumford medal for his researches in light and heat. He is corresponding member for the British Association for the Advancement of Science, and of the Cambridge Philosophical Society, is one of the twelve foreign members of the Physical Society of London, a foreign member of the Royal Society, and is a permanent member of the international commission for establishing electrical units.

Lieut. FRANCIS RAWN SHUNK is the son of the well-known Civil Engineer, Mr. W. F. SHUNK, and the grandson of Gov. F. R. SHUNK, of Pennsylvania. He was born in Harrisburg, Pa. in 1862, and graduated from West Point in 1887 at the head of his class. He was highly recommended by the Chief of Engineers as a member of the Board.

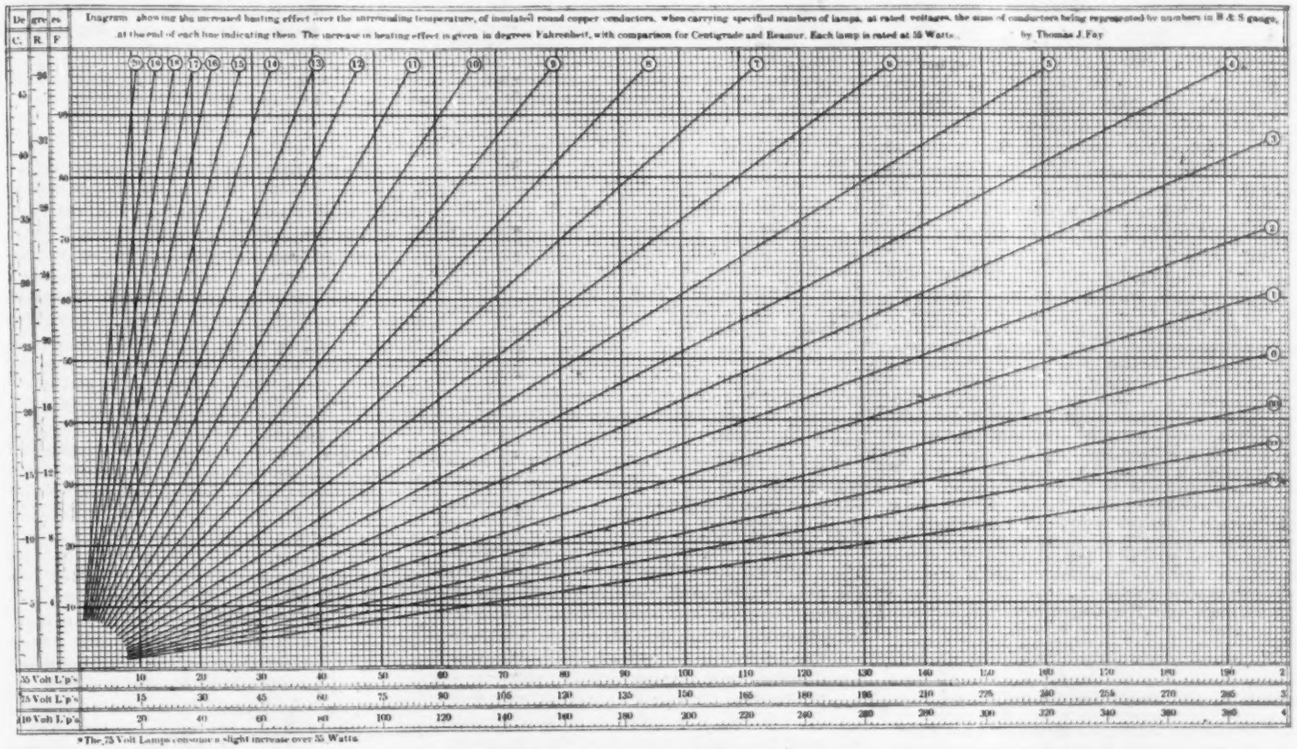


Diagram showing the increased heating effect over the surrounding temperature, of insulated round copper conductors, when carrying specified numbers of lamps, at rated voltages, the sizes of conductors being represented by numbers in B & S gauge, at the end of each line indicating them. The increase in heating effect is given in degrees Fahrenheit, with comparison for Centigrade and Reaumur. Each lamp is rated at 55 Watts.
by Thomas J. Fay
Degrees C. R. F
55 Volt L'p's
75 Volt L'p's
110 Volt L'p's

* The 75 Volt Lamps consume a slight increase over 55 Watts.

DIAGRAM FOR DETERMINING THE HEATING EFFECT OF ELECTRIC CURRENTS ON INSULATED COPPER WIRE.

NEW PUBLICATIONS.

—*Cornell University.* Her General and Technical Courses.—By FRANK C. PERKINS, Assoc. M. Am. Inst. Electrical Engineers. Publishers, John Wiley & Sons. New York, 1891. Oblong 8vo, 78 pp. Many photogravures. Price, $1.50.

As stated in the preface, this is "a pictorial and descriptive view of the opportunities offered by Cornell University for general and technical education." It is handsomely illustrated by photogravure portraits of the founders and faculty, and views of the exterior and interior of the various halls, class rooms, laboratories, etc., connected with the institution. Each view is accompanied by a description giving the purpose and scope of the various departments. For a thorough understanding of the field filled by Cornell University this is the best that can be desired.

—*Iowa Society of Civil Engineers and Surveyors.*— Proceedings of the third annual convention, held at Des Moines, Ia., December, 1890. Paper, 9 × 6 ins.; pp. 21. Published by the Society, Glenwood, Ia. Price, 35 cts.

The papers include the following: "Measurement of Earthwork in Railway Construction," R. G. Brown; "System of Cross Section Notes for Computing Earthwork Quantities in Street Improvements," Wm. Steyh; "The County Surveyor," Seth Dean.

—*Easement Curves.*—E. W. Muenscher. Paper, 5¾ × 8¾ ins.; pp. 12.

This is a reprint of a paper read before the Michigan Engineering Society at its twelfth annual convention, held at Lansing, Mich., January, 1891.

—*Technical Description of the Engineering Building.*—Paper, 6 × 9 ins., pp. 29, illustrated. The Massachusetts Institute of Technology, Boston, Mass.

—*Purification of Sewage and Water.* Part II. of the Report of the Massachusetts State Board of Health on Water and Water Supply.—HENRY P. WALCOTT, Chairman; FREDERIC P STEARNS, Chief Engineer. Boston, 1890. 8vo, cloth, 910 pp. With illustrations and copious index.

As space in this place forbids even a meager notice of the valuable contents of this volume, we have given a reasonably full abstract in another portion of this issue.

—*Progress Report of Artesian and Underflow Investigation* between the 97th degree of west longitude and the foot-hills of the Rocky Mountains, with maps and profiles. Part II. Prepared under the direction of the Secretary of Agriculture by EDWIN S, NETTLETON, C. E., Chief Engineer of Investigation. Put. Doc. 1891. Pamph., pp. 14 and 10 appendices.

The first part of this report was reviewed at length in our issue of Feb. 14, and abstracts from it were given in later issues. This volume is almost wholly made up of profiles showing the relative elevations of water-bearing strata along different lines in the section reported upon. Eight of the ten appendices consist of such profiles. The first appendix consists of a large map showing the location of artesian wells and waters, and the last appendix consists of tables of detailed information relating to the wells shown on the profiles.

TRADE PUBLICATIONS.

—*The Thurmond Automatic Car Coupler* for passenger and freight cars and locomotive tenders.—Thurmond Car Coupling Co., New York. Pamphlet, 5¾ × 9¼ ins., pp. 11, illustrated.

The pamphlet gives a description of this coupler and a list of roads using it.

SOCIETY PROCEEDINGS.

Engineers' Club of Cincinnati.—At the regular meeting on June 18 Mr. A. S. Hobby read an interesting paper on "Brick Masonry."

ENGINEERING NEWS

AND

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COMING TECHNICAL MEETINGS.

Engineers' Club of Kansas City.—July 13. Rooms, Baird Building. Secy., H. Goldmark.

Atlanta Society of Civil Engineers.—July 14. Secy., Parker N. Black, 39 Capitol Block.

Civil Engineers' Club of Cleveland.—July 14. Secy., A. H. Porter, 50 Euclid Ave.

Engineers' Club of St. Louis.—July 15. Secy., Arthur Thatcher, Room 801, Odd Fellows' building.

Engineers' Club of Cincinnati.—July 16. Secy., J. F. Wilson.

Scandinavian Engineering Society of Chicago.—July 16. Secy., T. G. Philfeldt, 113 Adams St.

Engineers' Society of Western Pennsylvania.—July 21. Secy., J. H. Harlow, Pittsburg, Pa.

Denver Society of Civil Engineers.—July 23. "Canals and Irrigation." Secy., Geo. H. Angell.

American Society of Swedish Engineers.—Aug. 1. At 250 Union St., Brooklyn and 347 North 9th St., Philadelphia.

Western Society of Engineers.—Aug. 5. Secy., O. W. Weston, 280 La Salle St., Chicago.

Civil Engineers' Society of St. Paul.—Aug. 3. Secy., C. L. Annan.

Engineers' Club of Minneapolis.—Aug. 6. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Association of Civil Engineers of Dallas.—Aug. 7. Secy., E. K. Smoot, 803 Commerce St.

Technical Society of the Pacific Coast.—Aug. 7. Secy., O. von Geldern, 819 Market St., San Francisco.

Civil Engineers' Association of Kansas.—Aug. 12. Secy., J. C. Herring, Wichita, Kan.

Engineering Association of the South.—Aug. 13. Secy., Chas. E. Lamareux, Vanderbilt University, Asheville, Tenn.

THE index to the last volume of ENGINEERING NEWS will be published with the issue for July 18, 1891.

THE rear collision on the New York, Lake Erie & Western R. R. at Ravenna, O., on July 3, by which 19 persons lost their lives and 10 were injured, is by far the most serious railway accident which has occurred since the great disasters at Quincy, Mass., on the Old Colony R. R., and at Shoemakersville, Pa., on the Philadelphia & Reading R. R., in August and September of last year. As nearly as can be determined from the facts now at hand, the cause of the collision is the old story—a rear brakeman neglected his duty just as he had neglected it before, just as hundreds of other brakemen neglect it every day. Here is what the standard code of train rules requires:

Sec. 99.—When a train is stopped by an accident or obstruction, the flagman must immediately go back with danger signals to stop any train moving in the same direction. At a point —— from the rear of his train he must place ONE torpedo on the rail; he must then continue to go back at least —— from the rear of his train, and place TWO torpedoes on the rail, 10 yds. apart (one rail length), when he may return to a point —— from the rear of his train, and he must remain there until recalled by the whistle of his engine; but if a passenger train is due within TEN minutes, he must remain until it arrives. When he comes in he will remove the torpedo nearest to the train, but the TWO torpedoes must be left on the rail as a caution signal to any following train.

Each road using the standard code fills in the blank distances in the above to suit itself. On the Erie road we believe it is the rule for the rear brakeman to go back 35 car-lengths.

Let us suppose for the sake of argument that in the case where a train stops on the open road, and the trainmen know that another train is not more than half an hour behind them, this rule is always carefully observed to the letter. Is it so observed when the trainmen know (or believe they know) that there is no following train within 20 miles? Does the flagman always start "immediately," or does he wait to find out why the train stopped and how long the detention is likely to be? Is he as careful to obey the rule when the train stops at a station not down on its schedule as when it stops on the open road? How thoroughly is the rule observed when a stop is made on a straight track in broad daylight?

These and similar questions are certainly worth investigating. They all have a direct bearing on the main question of all, which is: Is this rule generally observed, or is its observance generally required, except when in the judgment of the trainmen it is needed? If the judgment of the trainmen is really relied upon as to the degree of care necessary in guarding the rear of a train, we may well ask whether this is a sufficient reliance against accidents. The long list of collisions which are every week reported, with the resultant deaths, injuries and financial losses is sufficient answer to this question.

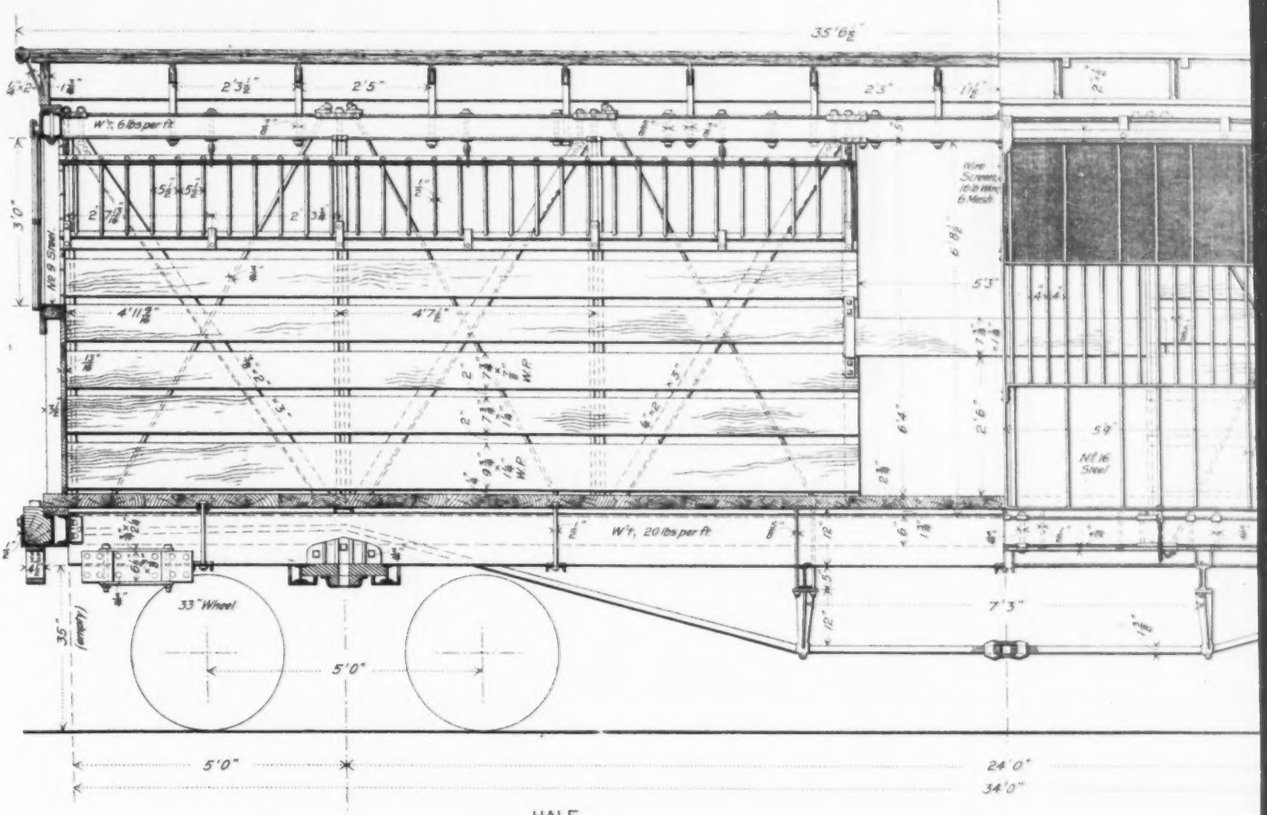
On the other hand, if the judgment of the trainmen is not a sufficient reliance, is it possible to so enforce rigid adherence to the precautions prescribed by the standard code as to secure a reasonable degree of safety? Can employees be disciplined always to obey the above rule, no matter how pleasant or how stormy the weather, no matter whether a train is expected within five minutes or five hours? It is extremely doubtful whether this is possible. Under a rigid military discipline a sentinel can be kept walking his beat when he knows there is absolutely no need whatever for it, though even then derelictions from duty are not unheard of. But railway employees at the present day cannot be kept under military discipline, or, indeed, under any discipline of which the majority of them do not appreciate the necessity.

THE lives lost in the Ravenna collision will not be lost in vain if the accident awakens in the public mind a realization of the frail protection against collisions afforded by the system of train movement in general use on American railways. In this case, from all the circumstances reported, it is altogether probable that the rear brakeman *forgot* that the fast freight was following close behind. The train was stopping at a station; the repairs on the engine were slight and the train might be ready to pull out at any minute; there was a half mile of straight track to the rear, and if a train came along it could see the tail lamps and stop. These are some of the reasons which may have caused the rear brakeman to be very leisurely in starting back with his lantern. Could better proof be needed of the dangers of a system which leaves a single employee to judge whether to protect the lives of half a hundred passengers the precautions laid down by the rules shall be observed?

This, it seems, is the chief lesson to be learned from the Ravenna collision. The officers of the Erie system deserve great credit for introducing the block system over a portion of their lines, when roads with much heavier traffic, and much better able financially to make improvements, have done nothing. It is to be hoped that the Ravenna collision will give a new impetus to extensions of the block system, on roads which have not begun its use as well as upon the Erie.

The production of rainfall by concussion, in the arid regions of the United States, is just now a favorite topic for the "funny man" of the daily press. But the experiment is to be actually made under the auspices of the United States Agricultural Department, and while we have the very thinnest hopes that any results of value will follow, it will be interesting as a scientific experiment Dynamite or rack-a-rock were at first proposed as the explosive agents, but these were found to be too heavy, and to add too much to the cost of the balloon to be used for raising them to the moisture-charged air stratum. The latest experiments have been conducted with an explosive gas compounded of oxygen and hydrogen. The tremendous force of this explosive, when fired by an electric spark sent up in the wire in the anchoring cables, has been demonstrated in the preliminary tests made near Washington, D. C. While rain did not follow the explosion, and was not expected with the quantity used, Dr. DYRENFURTH, who conducted the test, was officially requested to move his experimental station to some point more remote from the houses of those residing near the testing ground. Some arid spot in Kansas is now to be selected, and Dr. DYRENFURTH there proposes to plant balloons along a line two miles long, and to explode the gas by an electric current—and await results under an umbrella, perhaps.

The long-held theory that great battles, in our own and other wars, were immediately followed by heavy rainfall, has been very thoroughly investigated by Mr. EDWARD POWERS, C. E., in his "War and the Weather"; and as far as the records hold this theory is backed by fact in our own war. This Mr. POWERS, by the by, is directly responsible for the present experiments. As long ago as 1874 he interested Senator C. B. FARWELL, of Illinois, in his project, and through him presented a petition to Congress asking that body to appropriate a sum sufficient to make an experiment on an extended scale. Mr. POWERS now seems to be forgotten, and Senator FARWELL is generally regarded as the father of the scheme. Mr. POWERS suggested artillery as a means of producing the desired concussion; but while it is well shown by the records of various wars that rain very often follows heavy artillery firing, the later project for producing the aërial commotion required in the immediate neighborhood of the moisture-laden stratum promises more encouraging results. The most curious proof of the effect air of concussion upon rainfall is brought forward by Senator STANFORD. When this gentleman, with Mr. HUNTINGTON, was building the Central Pacific Railway



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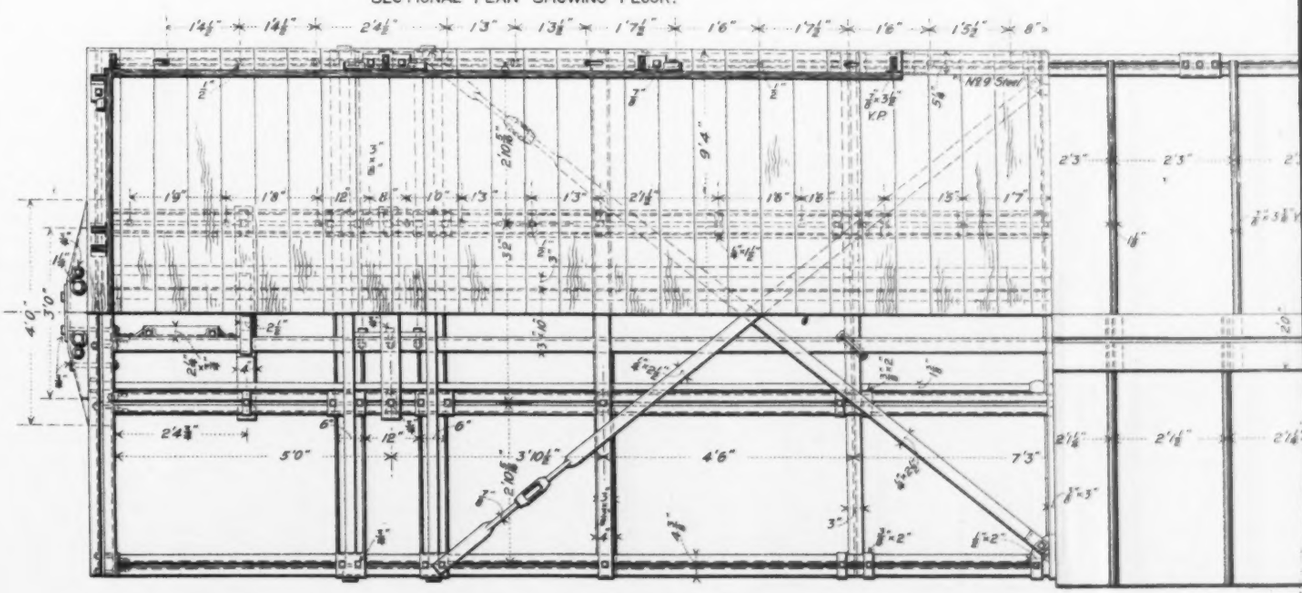
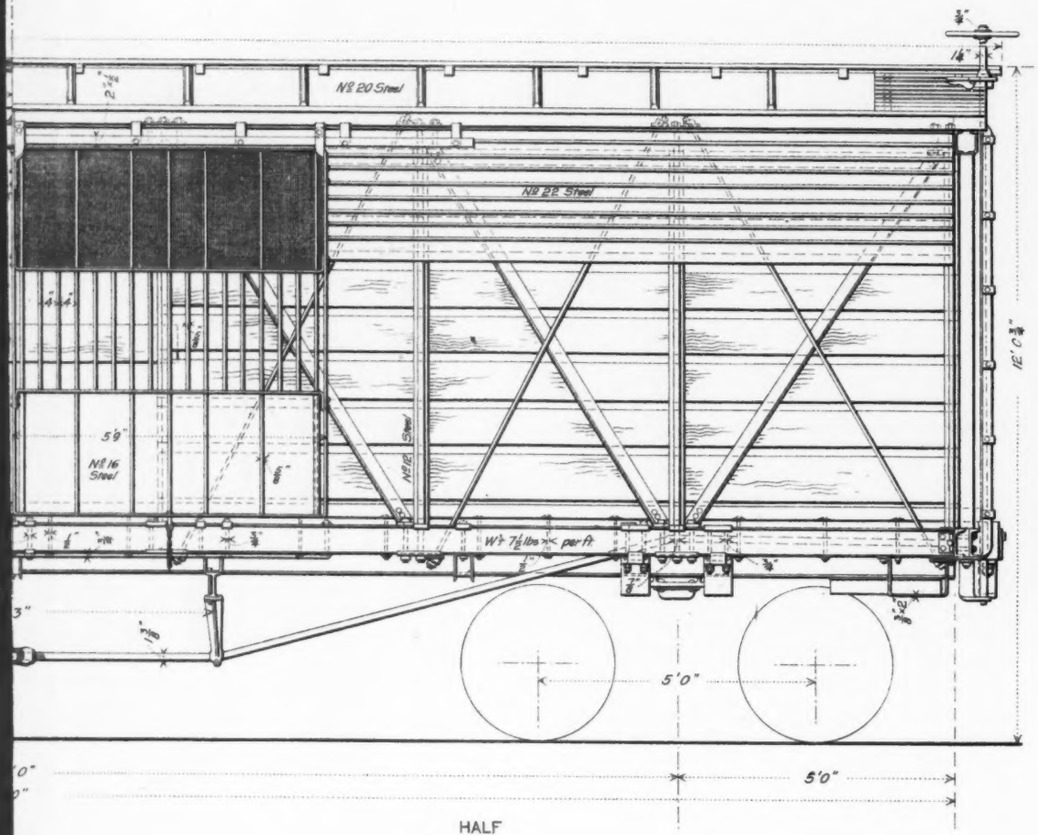
SECTIONAL PLAN SHOWING FLOOR.



PLAN OF BOTTOM FRAMING.



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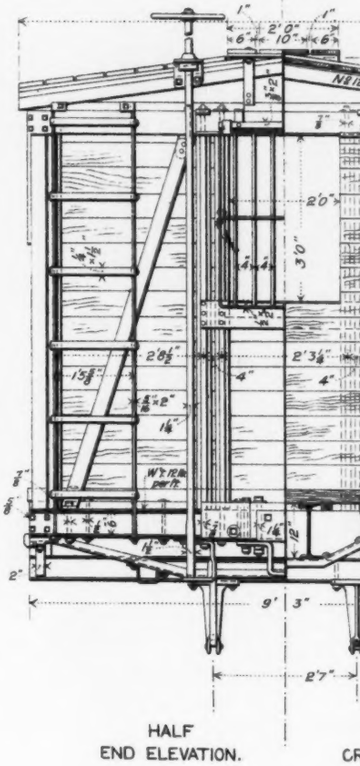
SIDE ELEVATION.



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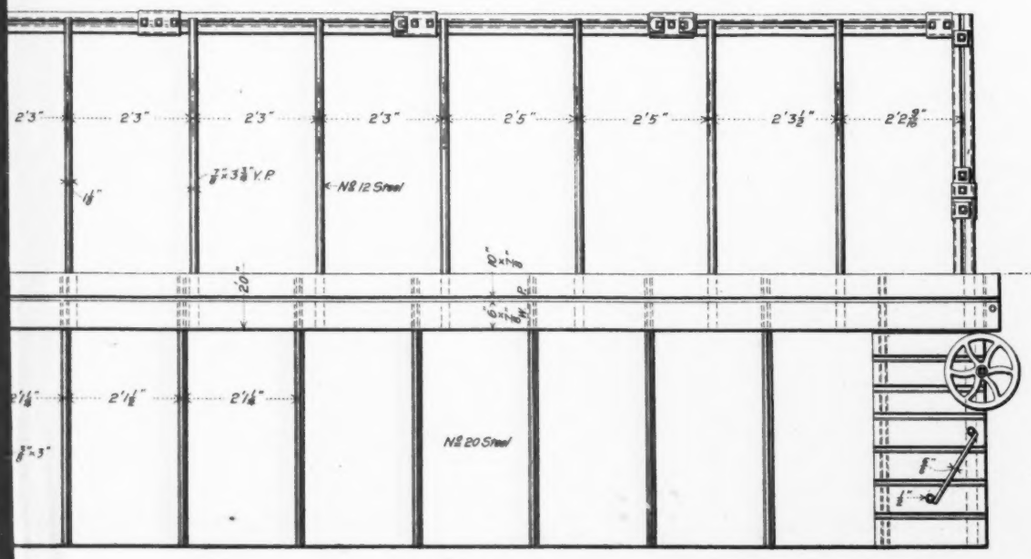
END ELEVATION.

PLAN, ROOF COVERING REMOVED.

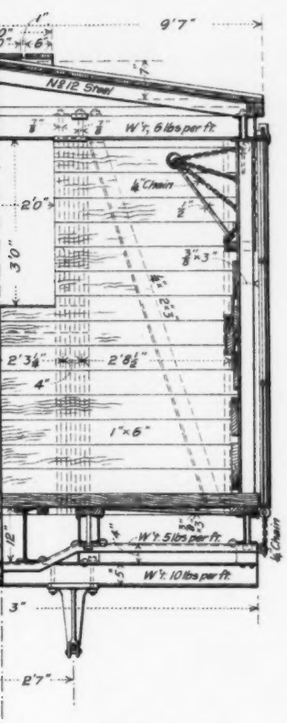


PLAN SHOWING ROOF.

STEEL STOC

BUILT BY

HARVEY STEEL C



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CROSS SECTION.

STOCK CAR,

BUILT BY

Y STEEL CAR CO.

LITH. CHAS. HART & SONS, 55 VESEY ST., N. Y.

through an arid belt, in which rain was never before known to fall, the heavy blasting required was followed by rain, and the rain lasted as long as the actual work of construction was being carried on. When active work of this nature ceased the rain stopped, and the region is now as dry as before. As this evidence comes from a most excellent authority, it is better proof even than the record of battles. If rain can be produced by the explosion of gaseous compounds, or by any other agent, the results would warrant a very considerable expenditure, for many millions of acres of fertile soil in the Far West only need moisture to make them productive. But we fear there are too many conditions to be filled to make this artificial downpour certain and efficient, even if it can be produced by the means now to be tested.

THE last bulletin of the U. S. Board on Geographic Names contains the principles adopted by that board for the official rendering of these names. This we elsewhere publish, and also note a second long list of "decisions of the board" regarding the proper spelling and designation of places, rivers, bays, etc., in the United States. Among these decisions is one abolishing the long-familiar name of "Fortress Monroe" for the works at Old Point Comfort, in Virginia. This ruling is based on an official order of the Secretary of War, dated Feb. 8, 1828, directing that these works be called "Fort Monroe," and not "Fortress Monroe"; and this order is to be hereafter observed in all official publications. Pittsburg, Pa., is to be spelled without the final "h," in accordance with the form adopted in its original charter of 1816. The final "h" seems to have been added by the Post Office Department, and that action is responsible for the divided local usage. Harrisburg, Pa., comes under the same ruling. Woods Holl, in Massachusetts, was originally "Wood's Hole." The present name was adopted by the summer residents of that place some years ago, and, as it has been accepted in official and local usage and by the Post Office Department, it is sustained. Colon is adopted for the older name of Aspinwall, on the Isthmus of Panama, but the U. S. Department of State still uses the form "Colon (Aspinwall)." This port was founded by the Panama Railroad Co. in 1850, and was named after WILLIAM H. ASPINWALL, one of the company's principal shareholders, and later President of the Pacific Mail Steamship Co. It was so called by the U. S. Government until 1882. In the latter year the Colombian Government adopted the name of Colon, the Spanish form of the patronymic of CHRISTOPHER COLUMBUS. It might be mentioned here that the Colombians are so sensitive on this point that they will consign to the dead-letter office all mail simply addressed to "Aspinwall." Haiti, the original native name, is the name now applied to that whole island in the West Indies, sometimes also called Santo Domingo. This island was called Espagnola by Columbus, who landed upon it on Dec. 6, 1492; and this was latinized into Hispaniola. In 1795, when France acquired the title to the whole island by a treaty with Spain, the name of Saint Dominique was given to it. The French were driven out and independence was declared in 1804, and negros revived the aboriginal name of Haiti. Shortly after this the Spaniards re-established themselves on the eastern part of the island and modified the French term to Santo Domingo. In 1821 the Spaniards again lost control and the whole island was under the dominion of the Republic of Haiti until 1844, when the eastern portion again asserted its independence and established the Dominican Republic. These two divisions yet remain. In the less conspicuous names the effort of the board is to simplify and shorten these and to generally abolish the sign of the possessive case—as Greenleaf for Greenleaf's Point; Greenbury for Greenbury's Point, etc. The purpose of this board is a laudable one, but it is evident that the task they have fallen heir to is one of serious proportions.

The Increase in Street-Railway Accidents.

Upon the casual newspaper reader the report of accidents causing the loss of life or limb makes little impression unless the accident involves a very large number of persons or unless for some reason, such as local associations or interest in some of the victims, his attention is definitely called to the occurrence. Deaths and injuries from all causes fill so large a part of the daily papers' space that they are passed by unread. This being the case, we can hardly expect that our readers have noticed with what increasing frequency accidents on street railways are reported in the daily journals. The number of minor casualties is so great, while the number of persons injured or killed in each accident is so few, seldom more than one or two, that the general public takes little interest in these accidents. The newspapers report them only briefly, and thus the fact of the increasing fatality which accompanies modern rapid transit is generally overlooked.

But let one collect the street-railway accidents of a single week as reported in the newspapers throughout the country, and he cannot fail to be impressed by the number of such accidents at the present time.

For example, during a few days in May we found the following accidents reported in different parts of the country:

MINNEAPOLIS, May 19.—Antonio Notore, the Italian laborer who was injured by an electric car on Lowry's Hill a week ago, and John Hanson, the young man run over by an interurban electric car near the Washington Av. bridge Sunday evening, and the 3-year old daughter of James Flaherty, who was run over by an electric car on Second St. North, Saturday noon, all died Monday.

CHICAGO, May 21.—A cable train of three cars ran away in the Washington St. Tunnel, owing to the failure of the brakes to act, and collided with a standing car in front. Two cars were badly smashed, but as most of the passengers jumped off before the collision there were no serious injuries.

RICHMOND, May 22.—An electric street car ran into a hook-and-ladder truck, injuring five men, two seriously.

ST. LOUIS, May 24.—Three cable-car collisions occurred yesterday. One was a grade-crossing collision between cars going in different directions, one was a collision of a car with a buggy, and in the third a woman was struck and rolled over by a car.

Of course an increase of casualties is the natural result of the increased speed of cable and electric cars. A street railway has a grade crossing at every block; and, as a rule, in thickly built-up portions of a city, an approaching car or train cannot be seen by those coming along the cross street until they are within less than one hundred feet of the crossing. Besides the crossings there are often vehicles or pedestrians moving along the tracks in either direction. A steam railway operating under such conditions would expect an increase in casualties with an increase in speed, and there is good evidence that the increase in speed due to the use of cable and electric roads has caused a great increase in the number of killed and injured.

The best statistics of street-railway accidents with which we are acquainted are those found in the reports of the Massachusetts State Railroad Commission. In the accompanying very interesting table, compiled from these reports, there is recorded for each year since 1871 the total mileage of street railways, the total miles run by cars or trains, the whole number of passengers carried, and the total number killed and injured.

We may note in passing that this table exhibits a most astonishing growth in city passenger traffic during the past score of years, and this too in one of the oldest states of the Union, whose cities had their days of rapid growth before the cities of the West were heard of. During only 20 years, the miles of road, number of car miles and number of passengers have all *more than quadrupled*.

TABLE I.—ACCIDENTS ON STREET RAILWAYS IN THE STATE OF MASSACHUSETTS DURING 20 YEARS. COMPILED FROM THE ANNUAL REPORTS OF THE STATE RAILROAD COMMISSION.

Year.	Miles of road.	Miles run.	Pass'gers carried.	Accidents. Killed.	Accidents. Injured
1871	161	5,721,969	36,776,695	9	43
1872	176	6,257,426	40,274,169	5	70
1873	204	6,592,658	43,557,636	4	67
1874	210	7,938,360	50,058,979	3	70
1875	217	8,228,651	50,441,776	4	26
1876	206	9,130,952	54,361,972	3	15
1877	218	9,268,565	52,203,472	5	22
1878	212	10,787,382	54,215,160	4	36
1879	223	11,198,858	57,704,437	4	31
1880	240	12,516,363	68,631,842	1	24
1881	265	13,172,746	75,172,746	7	27
1882	297	14,681,527	83,923,577	6	43
1883	306	15,357,504	86,2 9,796	5	55
1884	336	16,223,369	94,894,259	3	76
1885	375	18,167,619	100,746,786	15	81
1886	440	19,661,675	112,087,384	9	86
1887	507	20,625,846	124,787,328	8	123
1888	562	23,244,767	134,478,319	16	217
1889	621	24 259 491	148,189,403	8	349
1890	664	26,516,937	164,873,846	20	332

On Sept. 30, 1889, there was in operation 50½ miles of electric railway. On Sept. 30, 1890, there was in operation 160 miles of electric railway. It is thus apparent that the year 1890 is the only one in which the use of electric cars has been great enough to sensibly influence the accident record.

Not until the last year in the table, 1890, does the electric railway cut any considerable figure in the returns. About 50 miles were in operation, it is true, at the close of the fiscal year 1889; but this was not enough to affect materially the accident record, in any event. In 1890, however, 160 miles of electric road were in operation on Sept. 30; and we may fairly estimate 100 miles, or a little more than one-seventh the street railway mileage of the state, as the average mileage operated by electricity during the year.

To find the proportion of accidents to traffic on horse railways, we have averaged the figures for the 10 years 1879 to 1888, inclusive, in Table I, and find that during this period one person was killed for each 2,424,122 car miles traveled, or for each 13,833,186 passengers carried. But in the year 1890 there was one person killed to each 1,325,847 car miles traveled, or to each 8,243,692 passengers carried. It thus appears that the number of people killed on Massachusetts street railways during last year was not far from *twice* as great in proportion to the traffic as the average of the 10 years preceding the introduction of the electric railway; and this notwithstanding the fact that less than one-sixth the total mileage was operated by electricity in 1890. Of course it may be claimed that 1890 was a year of exceptionally heavy casualties on all the street railways; and this is certainly the explanation of a part of the increase. But it is certain also that the introduction of electric railways is responsible for a considerable portion of the growth in fatalities.

Comparing 1890 with the 10 years 1879 to 1888, with respect to accidents not resulting in death, we have the following:

Period.	Miles run per person injured.	Passengers carried per person injured.
1879-1888	216,895	1,237,706
Year 1890	75,533	468,392

This shows a much more serious increase in casualties in 1890 over the 10 years before the electric railway than the comparison on the basis of fatalities; but it is much more liable to error, for it is very probable that moderate injuries were more carefully reported in 1890 than in previous years.

That a part of the increase in accidents and injuries in 1890 was due to the substitution of electric traction for horses there is positive proof in the shape of statistics of accidents on the West End Street Ry. published in the Massachusetts

Commission's last report. We give the facts in tabular form, as follows:

ACCIDENTS ON WEST END ST. RY. FOR YEAR ENDING SEPT. 30, 1890.

	Horse cars.	Electric cars.
Mileage made	14,353,617	3,311,743
Per cent. of total mileage	81.25	18 75
Per cent. of accidents:		
To passengers getting on or off cars	73	27
To persons in the street	84	16
By collisions with vehicles	44	56
Per cent. of total accidents	68	32
Per cent of fatal accidents	64	36
Per cent. of non-fatal accidents	68	32

It appears from the above table that the electric cars on the West End road caused one accident for each 54,291 miles run, while the horse cars had one accident for each 109,569 miles run, so that the accidents were just about twice as many in proportion to car mileage on electric cars as on horse cars. At the close of the fiscal year which the above report covers, the West End Co. had 65.46 miles of electric road in operation. The amount of traffic was thus large enough to make the above figures and the conclusions drawn from them fairly reliable.

But it may be said, and in many cases said with truth, that the greater speed of transit of electric or cable cars over the horse lines is a benefit to the traveling public which more than offsets the increased dangers to life and limb. Faster cars enable persons of moderate means to find homes farther removed from the densely populated districts, where they can live in better health and at less expense. Even more important than this is the benefit to the public health due to the removal of the street-car horses and their stables, an improvement which alone probably saves far more lives than those sacrificed in electric-railway accidents.

These and other valid arguments might be brought up if there were need; but there is no need. It is not questioned that the modern systems of street-railway traffic giving a higher rate of speed than the old horse cars are here to stay and to multiply, and that it is for the benefit of the people at large that they should do so.

But because this is the case, there is all the more reason why the increase in accidents which has accompanied the increase in speed of city-transit lines should be carefully watched and kept down by every reasonable means. It should be distinctly understood that an increase in speed on a street railway means inevitably an increase in the number of accidents, and that as the speed increases above a certain point the increase in the casualties becomes more pronounced. An increase in speed from 8 to 12 miles per hour, for instance, would be a far more serious matter than an increase from 4 to 8 miles. The matter of regulating the speed of street railways is generally in the hands of the municipal authorities. They should see to it that the increase of speed does not pass the point of reasonable safety.

At the same time, as it is not to be expected that cars drawn by a mechanical motor will be kept down to the pace of horse cars, it is well to inquire what steps can be taken to lessen the number of accidents. The most obvious method is the provision of some form of safety fender which shall either pick up and carry or push to one side a person struck by the car. An exhaustive series of experiments were made last year under the direction of the Massachusetts Railroad Commission (see ENGINEERING NEWS, Feb. 21, 1891) to determine the best form of fender for street cars. These experiments showed that it was very difficult if not impossible to attach a fender to a common four-wheel car which would be of any value in saving life or limb; and that even with a double-truck car a thoroughly efficient fender is yet to be designed. As for the fenders in common use on street cars, the experiments indicated that many of them were worse than useless.

Concerning the need of an efficient fender on electric cars, the Commission spoke as follows:

> An electric car weighs twice as much as a horse car of the same size, while the new 25-ft. double-truck box cars of the West End St. Ry. Co. weigh 8 tons, or three times as much as the ordinary horse car. The maximum rate of speed of an electric car is twice as great as that of a horse car; and as electric power is developed the attainable rate of speed will be increased. On the horse car the horses serve as a fender, projecting 10 ft. in front of the dasher. A person struck by them stands a good chance of being thrown clear of the rails or of saving himself by catching hold of the harness. An efficient fender on electric cars is a public necessity.

But of even more importance than an efficient fender in saving life is the matter of brake power. The danger in increasing the speed of street cars (if we except casualties to persons who persist in jumping on and off cars in rapid motion) lies in the greater difficulty of stopping. The distance which a car will run before stopping after the brakes are applied varies as the square of its speed, supposing the retarding action of the brakes to be a constant.

This matter also has been investigated by the Massachusetts Railroad Commission. A series of experiments was made in the spring of 1890 to determine the distance in which an electric car could be stopped when running at different speeds. The results are condensed in the following table:

Speed of car. Miles per hour.	Minimum stop. Feet.	Maximum stop. Feet.		Average stop. Feet.
7 to 10	23	71	[7 stops]	49
10 to 12	42.5	85	[5 stops]	61
12 to 15	56	96	[7 stops	79
15 to 21	61.5	157	[5 stops]	113

These experiments showed a great variation in the length of stops made under apparently similar conditions; and also an exceedingly low efficiency of the brake apparatus, which we understand was the common street car hand brake, in which a chain winds around a vertical shaft which is turned by the driver. To see this deficiency in the brake power more clearly, let us compare the results of these experiments with those obtained in the use of air brakes on railway trains. According to the best authorities, the maximum retarding force of brakes at speeds below 15 or 20 miles per hour may be taken as one-fifth the weight to which the brakes are applied. In ordinary practice, however, perhaps one-seventh is a fair ratio for maximum efficiency. Adopting it as a factor for computing the length of stop of a street car at various speeds we have the following:

TABLE II.

DISTANCE IN WHICH A CAR CAN BE STOPPED BY BRAKES HAVING A RATIO OF EFFICIENCY OF ONE-SEVENTH.

Speed. Miles per hour.	*Inertia in ft. lbs. of each lb. of the car.	Distance in which car would be stopped. Ft.
5	0.89	6.23
6	1.28	8.96
7	1.74	12.18
8	2.27	15.89
9	2.88	20.16
10	3.55	24 85
11	4 30	30.10
12	5.11	35.77
13	6.00	42.00
14	6.96	48.72
15	7 99	55.93
16	9.09	63.63
17	10.26	71.82
18	11.50	80.50
19	12.82	89.74
20	14.20	99.40

* Figures in this column are taken from the table in WELLINGTON'S "Economic Theory of the Location of Railways," p. 335, which is calculated by the familiar formula, velocity head $= \frac{v^2}{2g}$, the "velocity head" signifying the foot pounds of inertia in each pound of the moving body. To this quantity is added 6 14% of itself, which is the estimated additional energy resident in the rotating wheels of the car.

Comparing now the figures in this table with the results obtained in the Massachusetts experiments above, the very low efficiency of the brake there used is apparent. As the exact speeds from which the stops were made are not given, the average efficiency attained can only be approximated; but it was considerably less than one-tenth, except in the stops from highest speed, as may be readily seen by considering the decimal point in the second column of Table II. moved one place to the right, and comparing the quantities with the results of the Massachusetts experiments.

Does this very low efficiency attained in the Massachusetts experiments represent fair average practice on electric street car lines at the present day? That it fairly represents average practice on the West End Street Railway will scarcely be questioned, since the managers of the company themselves selected the car for the experiments. The West End Co. has an excellent reputation for progressiveness and careful management, and it may fairly be assumed that the brakes on their cars are at least up to the average.

As to the brakes on cable railway lines, we are inclined to the belief that they could show somewhat better results than this. If we are rightly informed, the most common brake for cable cars is the lever brake, while the electric cars are generally fitted with the old style horse car brake, in which a chain winds around a vertical shaft which is turned by a crank on the upper end. With this brake the driver is sometimes caught unprepared and has to "take up the slack" of his chain before he can apply the brake with full force. Moreover, while with a light horse car the driver has little difficulty in applying the brake to the point of maximum efficiency, we question whether on a heavy electric car this old style brake is sufficiently powerful. A man can exert far more force on a lever, like that used on the Philadelphia cable cars, for instance, than on the crank turning in a horizontal plane, which is in common use on horse and electric cars.

The gain in efficiency of brakes on steam railways by substituting compressed air for hand power has been so great that we are naturally led to inquire whether a similar gain can be made on street railways. Nothing can definitely settle this question save careful experiments. The probabilities, however, are that while no such great gain could be made as has been made on steam railways for obvious reasons, yet a considerable gain well worth all it would cost could be made. The first gain would be in reducing the loss of time in applying the brakes with their full force, which we suspect to have been one important cause of low efficiency in the Massachusetts experiments. A gain might also be made in the more powerful and more uniform pressure with which the brake would be held against the wheel.

Whether the maximum efficiency which can ever be obtained with brakes applied to the wheels of a street car will be greater or less than that obtainable in ordinary railway service, is another question as to which we are still in the dark. On the one hand, the very low speed of street cars compared with railway trains should greatly increase the efficiency of the brakes. On the other hand, the condition of the rail on street lines varies far more than on ordinary railways. At times in city streets the black, greasy mud or even the finely ground dust probably forms quite an efficient lubricant between the wheel and brakeshoe, as well as between the wheel and the rail. But the more gritty dust which is blown on the rail where the track runs through unpaved streets may at times increase the possible brake efficiency above that obtainable on a clean rail. It is also possible in street railway service to increase the efficiency of the brakes by applying sand to the rail, which is, of course, out of the question on the cars of an ordinary railway train. Other important differences affecting the efficiency of the brakes will doubtless occur to the reader.

Besides the chances for improvement in brakes applied to the wheel, there are two other possible methods of decreasing the length of stop of street cars. The first of these is the application of sliding shoes to the cars with mechanism to throw the weight of the car upon them for an emergency

stop. On certain cable incline railways this has been done, and the friction has been further increased by making the shoe wedge-shaped to grip the head of the rail. The form of the rail on street lines would make this latter feature impracticable, and the sole reliance would have to be the weight of the car resting upon the sliding shoe. The friction of a car sliding on skidded wheels is less than that with the brakes applied to the full force possible without skidding the wheels. But according to our modern knowledge of the laws of friction, a car sliding on shoes would stop quicker than when sliding on skidded wheels. This would especially be the case if sand were applied; and if this were done an increased efficiency would perhaps be obtained over the maximum possible with brakes applied to the wheels. Suppose it were possible to secure a coefficient of friction of one-fourth between the sliding shoe and the rail. Then a car moving at 5 miles an hour could be stopped in 3.56 ft., one moving at 10 miles an hour in 14.20 ft. Even if one-fifth were the maximum attainable coefficient, the car could be stopped in 17.75 ft. from a speed of 10 miles per hour. It is yet to be proved, however, that efficiencies approaching this cannot be attained with brakes applied to the wheels; and there are certainly many obstacles to the design and use of a sliding shoe brake such as we have outlined.

The other possible method of reducing the length of stop of electric cars is by reversing the motor. It has always been a tantalizing possibility of the electric traction system that instead of wasting the energy of the moving car by applying the brakes when making a stop or running down hill, the motor might be made to run backward and generate electricity which would be transmitted to the line wire. This still remains a possibility only, however: and the question of the present discussion is, can we gain anything in quickness of stop by reversing the motor instead of applying the brakes?

The answer to this question evidently depends primarily on the relation between the power of the motor and the weight of the car. Let us assume, however, an 8-ton car with a motor capable of generating 40 effective horse-power. When the car is moving at 10 miles per hour (or $14\frac{2}{3}$ ft. per second) its total inertia in foot pounds equals the weight, 16,000 lbs., multiplied by the velocity head, which we find in Table II. to be 3.55, making the total energy to be absorbed before the car will stop 56,800 ft. lbs. Then as 40 HP. equals 22,000 ft. lbs. per second, if the motor is reversed with its full force the car will stop in $56{,}800 \div 22{,}000 = 2.55$ seconds. The average speed during the stop may be taken as $\frac{14\frac{2}{3}}{2} = 7\frac{1}{3}$ ft. per second, so the car will be stopped in a distance of $7\frac{1}{3} \times 2.55 = 18.70$ ft. As seen by Table II., this is not much better than what is practically possible with the most efficient brakes applied to the wheels.

The great, if not insurmountable, difficulties in designing a motor and driving gear which could be instantly reversed from full speed without damage, and the fact that little could be gained in shortening the length of stop if the feat were accomplished, will probably suffice to discourage efforts in this direction.

From all the data available, therefore, it may be concluded that those who would increase the safety of electric or cable street cars and thus make practicable higher rates of speed than those now attained, have the best opportunities of success by improving the ordinary brake gear, increasing its strength and stiffness, and applying power to move it in place of the driver's muscle; in short, just the methods by which the brakes on steam railways have reached their present efficiency. The urgent need of action in this direction has, we believe, been made sufficiently clear.

CORRESPONDENCE.

The "Lake Marine" vs. Census Bulletin No. 29.

SHARPSVILLE, Pa., June 18, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The tabulations and classifications of the lake marine, given in a report of the Commission, were made by a member of the Commission, from the Treasury Department "Annual List" of the merchant marine of the United States, the only complete and competent record of the registered and enrolled vessels of this country. The several exhibits of performance, earnings and expenses, of individual vessels, steam and sail, which appear in the report, were compiled from the logs and account books of the vessels respectively. The tables showing per cent. of expense to earnings of several vessels were computed by the Commission. The classification by groups of 100 ton range, of the lake marine as it existed Dec. 31, 1889, which appears in the report, is more explicit than any elsewhere published. It covers the entire marine of the lakes (Lake Champlain excepted).

Census Bulletin No. 29 (Feb. 4, 1891), prepared for the purpose of showing the changes that have taken place in the "floating equipment" of the Great Lakes since 1886, contains a table which on the face of it appears as an exhibit of the lake marine as it existed in 1889. The table, however, presents a view of certain classes only of the vessels of the lakes; the bureau having seen fit to omit from this exhibit a large amount of tonnage, mention of which was in its judgment unnecessary to the showing (of changes as aforesaid) for making of which the Bulletin was compiled.

The figures of this Bulletin have been copied by the *Marine Review*, and by many journals, technological and other, without any accompanying mention of the fact that the Bulletin gives only a partial showing of the lake marine. We call attention to this matter in order that those who have compared the figures of the Bulletin with those of our exhibit of the entire lake marine, as it existed in December, 1889, may understand the cause of the wide discrepancies between the two exhibits in question. Census Bulletin No. 66 (May, 1891) gives exhibits of the entire lake marine as it existed December, 1889, and in the total number of sailing and steam vessels, respectively, hailing from United States ports on the Great Lakes (Champlain not included in the Canal Commission tables), agrees with the exhibit for 1889, found in the report of the Commission.*

LAKE MARINE (EXCLUSIVE OF LAKE CHAMPLAIN) DEC. 31, 1889, AS EXHIBITED BY CENSUS BULLETIN NO. 66 (MAY, 1891) AND BY SHIP CANAL REPORT (FEBRUARY, 1891).

Census Bulletin No. 66 Steam vessels.		Ship Canal Report. Steam vessels.	
Paddle steamers	59	Paddle steamers	61
Screws, including tugs, ferryboats and pile-drivers	1,249	Screws, including tugs and everything except as below	1,273
Sand-boats, dredgers and fireboats	12	Steam lighters	2
Steam lighters	4	Steam canal-boats	55
"Unclassified"	52	Yachts	44
Yachts	52	Total steam	1,435
Total	1,428		
Sailing vessels.		**Sailing vessels.**	
Schooners, barges, scows, yachts and one "yawl"	1,217	Schooners, schooner yachts, barks (3), and one "rigged barge"	1,215
Sloops, including yachts	42	Sloops and sloop yachts	32
Total sailing	1,259	Total sailing	1,247
Aggregate vessels	2,687	Aggregate vessels	2,682

Following its statements that the entire report of the Canal Commission (relative to applicability of lake craft to canal service) is based on a consideration of the "inferior" vessels of the lakes, only, and that these inferior vessels (the "little" craft, that could get through locks 300 × 44 ft. in the clear, with 15 ft. of water on the sills) are "fast being removed from the lake marine," the *Review* asserts that "the lakes own more steam vessels of 1,500 to 2,500 tons than the combined ownership of this class of vessels in all other parts of the country. This class of fast steam tonnage is used in the ore and coal trade of the lakes. Canal vessels cannot compete for the business." Why draw the line at 2,500 tons? There were in service on the lakes, in 1889, several screw steamers of over 2,600 tons, "gross" tonnage. There were 3 of 2,669 "gross" tons each. We will count in everything over 1,500 gross tons measurement, including 5 paddle steamers that are not ore carriers.

The list for 1889, given in the Canal Commission report, shows 143 "steamers" of 1,500 tons and upward, on the lakes (exclusive of Lake Champlain), but this list did not include 3 passenger steamers which may properly be rated in this class. Including these 3 vessels there were on the northwestern lakes, in 1889, one hundred and forty-six (146) steam vessels of 1,500 gross tons and upward.

	Tons.
Three of these were "composite" vessels, aggregating	6,401
Twenty-one (including 3 paddles) were of steel	45,642
Twenty (including 2 paddles) were of iron, aggregating	37,807
So aggregate tonnage in steel, iron and comp. was	89,850
Aggregate tonnage in wood was	188,041
Grand aggregate of steamers over 1,500 tons	277,891

Of steamers of 1,500 gross tons and upward owned at tidewater ports of the United States (exclusive of Mississippi River steamers, and not including any of the great ocean "liners") there were, in 1889, 148.

Of these, 8 were of steel, aggregating	6,684
And 108 were of iron, aggregating	281,557
Aggregate tonnage, iron and steel	287,641
Thirty-seven were of wood, aggregating	64,586
Grand aggregate of tidewater steamers over 1,500 tons	352,227

The average tonnage of the above specified steel steamers of the lakes is	2,173.42
Average tonnage of steel steamers of tidewater ports	2,028.00
Average tonnage of iron, steel and composite steamers of the lakes (1889) was	2,042.04

Of the 148 steam vessels over 1,500 tons owned at tidewater ports in 1889, 111, or 75% of the number, were of metal. Of the lake equipment of same class 30.1% (including the composite vessels) were of metal. In 1889 there were owned at the port of New York 68 steamers of 1,500 tons and upward, having aggregate gross tonnage of 164,934 tons. Of this fleet 59 vessels were of metal, having aggregate gross tonnage of 147,288 tons, or 57,438 tons in excess of the entire metal tonnage of the lakes. As seen above, the aggregate tidewater tonnage (over 1,500 tons) was 74,336 tons in excess of lake tonnage of like class. The lake fleet of freight steamers is a magnificent one, and commands the admiration of every competent observer the world over. The *Marine Review* deserves the thanks of the commercial world for its excellent illustrations of the principal vessels of this fleet. It will, however, get no thanks from the ship-owners of the lakes for putting them in the attitude of unconscionable braggarts.

The foregoing statement shows the misleading quality of the assertions of the *Review* in this particular matter. As to its assertion that the biggest and fastest steamers of the lakes are the ore and coal-carriers of the lakes to the exclusion of vessels of other classes, we have to repeat, what the report of the Canal Commission fully sets forth, that more than 25% of the ore delivered at Lake Erie ports for supply of the Allegheny-Mahoning-Shenango district comes in sailing vessels, and that of the entire fleet of ore and coal-carriers on the lakes in 1889 (the year with which the report of the Commission deals, and the latest year for which we have, at this time, authenticated returns of the shipping of the lakes), more than 50% were applicable to service in a canal such as that recommended by the Commission.

In making its investigations the Commission particularly analyzed the business of the Lake Shore & Michigan Southern Ry. Co.'s docks, at Ashtabula Harbor, for the reason that the receipts of ore at these docks are materially greater than those of any other one system of docks on the lakes. Of the 1,039,920 gross tons of ore received at said docks in 1889 25.1% came in sailing vessels, and of the sailing vessels bringing it 94.2% were of less than 1,000 tons, gross measurement. Fifty-three and seven-tenths (53.7) % were between 600 and 900 tons, and 33% were below 600 tons measurement. Twenty-four and one-half (24.5) % of all the sailing vessels delivering ore at said docks in 1889 have been built since Jan. 1, 1890, and 12.26% since Jan. 1, 1885. Of the steam vessels bringing ore to said docks in 1889 55.5% were under 1,500 tons gross, measurement, and 73.4% were under 1,800 tons. Of the steam fleet delivering ore, as aforesaid, over 92% have been built since 1872, and of those built since 1872, 52% are of less than 1,500 tons, gross. Of those of less than 1,500 tons 17 have been built within the three years ending June 30, 1889, and 23 have been built since June 30, 1886. Of these 23 twelve are of less than 1,000 tons each.

The average ore cargo delivered at said docks at Ashtabula in 1889, by steam and sail together, was under 1,500 gross tons.* The average total delivery of ore at said docks in 1889, per vessel, steam and sail taken together, was 3,924,226 gross tons. Average total delivery of ore by the steamers (total number of steamers into total number of tons delivered), was 4,950 tons. Of the schooners delivering ore as aforesaid, one group of 25 delivered average total of 5,298.84 tons; and one group of 10 delivered average total of 6,940.1 tons. Of two schooners built in 1884, of 863 and 845 gross tonnage, respectively, one delivered 8,939 and the other 8,901 gross tons. Of the coal shipped (in 1889) from L. S. & M. S. Ry. docks at Ashtabula, 35.1% went in sailing vessels. The average of all cargoes of coal so shipped was 1,077.1 gross tons. Of 104 cargoes shipped in 101 several vessels, 73% were of less than 1,250 gross tons. Of 139 vessels taking coal cargoes, 62½% were of less than 1,430 gross tons coal capa-

*See following statement, showing figures of Census Bulletin No. 66 and of Ship Canal Report, for vessels on lakes (exclusive of Champlain), Dec. 31, 1889:

*Total number of cargoes, 606.

city. These facts refute the assertion that "the big, fast steamers" do the ore and coal carrying of the lakes to the exclusion of vessels that are neither *very* big nor *very* fast.

The statement of the *Review* that the schooners are fast disappearing from the lakes is astonishingly audacious. The schooners are so far from disappearing that *those of 400 tons and upward* have increased in number at a rate exceeding that of the increase of the lake marine as a whole. There has been a decrease since 1872 in total number of sailing vessels on the Northwestern lakes; but this decrease has been entirely in vessels *below* 400 *tons* measurement. Total vessels (all classes) on lakes (exclusive of Champlain) in 1872 was 2,090; in 1889 it was 2,682. Ratio of increase: 1.2832. Ratio of increase of sailing vessels between 400 and 1,500 tons: 2.026. Ratio of increase of steam vessels (*all classes*), 2.148.

RATIO OF INCREASE OF STEAMERS.

1872-1889	Between 500 and 600 tons	2.1966
	" 1,000 " 1,100 "	2.3333
	" 1,100 " 1,200 "	2.1515
	" 1,200 " 1,300 "	1.000
	" 1,400 " 1,500 "	2.750

RATIO OF INCREASE OF SAIL VESSELS.

1872-1889	Between 600 and 700 tons	2.000
	" 700 " 800 "	2.3000
	" 800 " 900 "	3.1666
	" 900 " 1,000 "	14.000
	" 1,000 " 1,100 "	5.000

Decrease in sailing vessels under 200 tons, 173; between 200 and 400 tons, 120; aggregate decrease, 293. *Increase* in vessels *above* 400 tons, 120. Ultimate decrease, 173.

Total sailing vessels in 1889, of 300 and up to 400 tons.	102
Four hundred tons and upward	298
Aggregate	400
Tonnage	54 166
"	161,238
"	215,404

Of these 400 twenty are over 1,000 tons, aggregating 25,437 tons; average, about 1,272 tons. By topping their booms the largest of these can pass a lock 300 ft. clear length. One schooner, 1,444 gross tons, is 231.4 × 40.3 ft.; one built in '82, of 1,676 tons, is 263.7 ft. × 38.4 ft.; one built in '83, of 1,847 tons, is 278.8 ft. × 38.8 ft.

These vessels can make more money at lake and canal rates than they can at lake rates. This is clearly shown in report, appendix "F." Exclusive of the vessels of over 1,000 tons we have 189,967 tons of sailing craft exactly suited to canal work. This fleet has carrying capacity of 247,241 gross tons of ore, and in 12 round trips would carry down the canal 3,000,000 tons and bring back 2,700,000 tons of coal. That is the sailing fleet only. Of steamers between 500 and 1,200 gross tons, in 1889 there were 151. Increase since 1872, 57; ratio, 1.451. Of steamers between 400 and 1,600 gross tons there were, in '89, 248. Increase, 91; ratio, 1.580. Of steamers between 1,300 and 1,400 tons there were 23 in '89; increase of 22 since 1872.

Increase in number of steamers (including all classes) 1872 to Dec. 31, '89, 765. Increase in vessels below 200 tons = 482; between 200 and 400 tons = 65; total increase in classes below 400 tons = 547. Decrease between 400 and 500 tons = 13; between 600 and 700 tons = 7. Increase between 400 and 1,600 tons = 111. In 1872 the biggest steamer measured 1,575 tons. In 1889 there were 127 above 1,600 tons, of which 3 were paddles.

"Canal" steamers, of 500 to 600 and from 700 to 1,200 are not "disappearing." The ratio of increase in these classes is much greater than that of increase of steamers altogether. In 1889 there were on the lakes, of screw steamers between 400 and 1,200 tons, 178; between 400 and 1,300 tons, 198; between 400 and 1,400 tons, 221; between 400 and 1,500 tons, 232. In addition to our fleet of 380 "canal" schooners we have a fleet of at least 200 steamers suited to canal work.

A canal locks of the dimensions specified by the Commission (315 ft. quoin to quoin, with 45 ft. clear width) will pass vessels of the *Corona* class (steel steamers 293½ × 40.8 ft.), ranging from 2,400 to 2,500 tons gross measurement. The *Corona* can carry 2,000 tons on 14-ft. draft. Having no more than 50 tons of fuel on board she could carry 2,500 tons of cargo in the canal. Steamers of the *Omaha* class (15×34.1 ft., 1,231.08 tons gross) can carry 1,400 to 1,500 tons in the canal. The *Cambria* (iron, 280 × 40 ft., with 50 tons fuel on board) can carry 2,000 tons in the canal. In 1889 the *Cambria* made 36 round trips between Escanaba and Cleveland, carrying average of 2,319 tons of ore, returning always light. In average season she could make 19 round trips between Escanaba and Pittsburg, carrying 2,000 tons ore down and bringing 2,000 tons coal up each trip. So in the season she would carry 76,000 tons of freight. In 1889 she carried 83,484 tons 547 miles, equal to 45,655,748 ton-miles. Distance, Escanaba to Conneaut Harbor, 600 miles; Conneaut to Pittsburg, 124 miles; total = 728 miles. So in Escanaba-Pittsburg trade she would make (76,000 × 728) 55,328,000 ton-miles. At the rates prevailing in lake trade in 1889 she earned, on her 83,484 tons ore, $80,160. The through rate on ore from Escanaba to Pittsburg (lake and rail) averaged $2.01 per ton. Now, if the ship were to get $1.20 only per ton for her 76,000 tons of lake and canal freight, she would earn $91,200, or $11,040 more than she earned in making her 36 trips. Perhaps the cost of the 19 round trips loaded both ways between Conneaut and Escanaba would be 70% of that of the 36 round trips loaded only one way, between Cleveland and Escanaba. The economy in lake service would be very considerable.

The canal report gives several computations, based on actual lake performance of steamers and sailing vessels, respectively, supporting the statement that vessels like the *Cambria* would find the lake and canal traffic more profitable than their present lake traffic. The advantage of the canal to the iron producers of the Ohio and Pennsylvania districts hereinbefore named is indicated by the above-mentioned difference in through rates on ore: without the canal, $2.01; with the canal, $1.20 per ton. Were the completion of the canal within a given time an assured event, vessels would be built, in anticipation of the opening of the waterway, to carry fully 3,000 gross tons on 14 ft. draft. Even now (June 1891) we have the new steamer *E. C. Pope* bringing 2,741 gross tons of ore from Lake Superior *on 14 ft. 1 in. draft*. To be sure, the *Pope* is 337 × 42 ft., and would not pass locks of the size recommended for the ship canal; but a steamer 300 × 44 ft. would pass such locks, and would carry 3,000 gross tons on 14 ft. of water, exclusive of canal fuel. But the current practice in building of lake freight carriers will supply all the "canal" craft necessary to a full utilization of the canal.

Of the one hundred and eleven (111) screw steamers built in 1889 seventy-one (71) % were below 1,500 tons gross. Of the 50 above 300 tons measurement 58% are distinctly suited to canal service, and 4.% are entirely available for such service. Of schooners built in 1889 there were 11 between 300 and 1,200 tons gross. In 1888 there were built on the lakes 21 steamers (exclusive of paddles) of from 400 to 1,500 gross tons and 3 between 299 and 400 tons and 7 schooners of over 300 tons. Thus in the two years (1888 and 1889) we find built on the lakes 60 "canal" vessels, viz., 39 screw steamers and 21 sailing vessels.

The *Review*, continuing its practice of "posting" people, legislators and commissioners and the like, as "poorly informed" and as "blunderers," may perhaps advise the people who build these "inferior" vessels that they are "very unwise." We do not feel called upon to defend the course of these people. We believe that they know what they are about. We take this opportunity, however, for offering, for the consideration of those interested in the lake marine, the proposition that the establishment of the canal, having capacity as proposed, will induce extensive building of vessels, appropriate to navigation of such waterway, that will be much better suited to lake navigation than is any vessel proportioned so that she needs more than 16 ft. of water to enable her to load to her full carrying capacity.

J. M. GOODWIN,
Member Ship-Canal Commission of Pennsylvania.

The Suspension System of Fire Proof Floor Construction.

Carnegie, Phipps & Co., Limited.
PITTSBURG, July 8, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to my article in your last week's issue I beg leave to advise that the rods shown on Fig. 4 as ¾ in diameter, should be ⅝ in. diameter. These rods are no essential feature of the construction, having merely been placed there to keep the strap from slipping, which, of course, is avoided when the fire proof blocks are close together, as they would be in a complete floor of this kind.

Noting your comments, I will simply remark that this floor has been figured for a uniformly distributed load of 100 lbs. per sq. ft., as per assumptions clearly stated. If we had desired 300 lbs. per sq. ft., as is suggested—which is 125 lbs. more than the usual amount required by building laws for office buildings—it would be necessary to use 20-in. 64-lb. steel beams, the straps to be ⅞ × 1½ in., welded to ¾-in. rounds at ends, which would run through the upper web of beams and be held by nuts. For this load the approximate cost would be 54 cts. per sq. ft. of floor.

Your remarks as to the loss of strength at connections have been considered, inasmuch as I state in the explanation that the detail of connections must be of sufficient strength to take the strain coming upon it.

As to corrosion, it is supposed that the strap is entirely covered with cement, and thus, being kept free from moisture, corrosion is prevented. Yours truly,

F. H. KINDE, Chief Engineer.

The Production of Phosphate of Lime.

I.

The fact is little realized by people at large that modern civilization is almost wholly dependent on the fossil remains of the plant and animal life which flourished in past geologic ages. It is well understood by engineers and scientists that our modern civilization is, so far as we now see, wholly dependent on the carbon stored by fossil plants. It is not so well understood that we are also largely dependent on the fossil remains of the animal life of past geologic eras for a continuance of modern life under its present conditions.

Such, however, is the actual fact. The ultimate source of food for the race is the soil, and this cannot indefinitely go on yielding grain and fruit of any sort without a return being made. No matter how rich or how deep the soil may seem to be, constant cropping with no return will take from it the elements necessary to its fertility; and such vegetable growth as takes place will be lacking in some of the essentials which animal life demands. The most important element whose return to the soil is necessary is phosphorus. Ammonia and carbon, equally necessary to plant life, can be obtained from the air, but phosphorus must be returned to the soil in the shape of a "fertilizer" of some sort or other, or the plants containing this element, vitally important to animal life, cannot be grown with success.

A farming community can return to the soil all that it takes from it; but under modern civilization population is concentrating itself in cities whose wastes are no longer returned to the soil, but are carried off by rivers to be buried in alluvial deposits or lost in the sea.

As the use of "commercial fertilizers" of any sort is a thing of modern origin, it need hardly be said that the mining of fossil deposits of phosphate of lime is of still more recent date. In fact, it was not until 1843 that the office of phosphoric acid as a fertilizer of the soil was discovered.

From a recent article by Dr. FRANCIS WYATT in the *Scientific American* we take the following:

Sixty years ago the science of agriculture was unknown. Our grandfathers could not understand why lands once so fertile and productive should show signs of approaching exhaustion. The light only came to us after we had studied how outdoor plants live, whence they obtain their food, of what elements that food is composed, and how it is conveyed and absorbed into their organisms.

Having determined the elementary composition of plants, investigators directed their attention to the analysis of soils, in order to establish comparisons between virgin or uncultivated lands and old varieties which had long been tributaries to every kind of culture.

It was found that in the former there is an abundance of most of the dominating mineral ingredients discovered in plant organisms, whereas in the latter they either exist only in minute prrportions or are lacking altogether.

This is a most important stage in our progress! Argument is no longer necessary to prove that if agriculture is to continue to be the basis of national wealth and prosperity, means must be found of restoring to our soils the chief mineral element yearly taken away from them by the crops. This chief mineral element is phosphoric acid; and, since it plays the most important part in the functions of vegetation, it is necessarily the one most liable to be rapidly exhausted.

PHOSPHORIC ACID TAKEN FROM THE SOIL PER ACRE PER ANNUM, BY AVERAGE CROPS.

Wheat	30 lbs.	Buckwheat	40 lbs.
Maize	80 "	Hay	15 "
Oats	18 "	Turnips	45 "
Barley	18 "	Potatoes	52 "
Rye	25 "		

It was somewhere near the beginning of the present century that the farmers of England began to use crushed bones as a manure. Just why and how they had been brought to do so is shown in an article published in a scientific journal in the year 1830, the writer saying:

As to the earthy matter or phosphate of lime contained in the bones, we may disregard it. It is insoluble and indestructible, and cannot serve as a manure, even in a damp soil and with a combination of circumstances analytically stronger than any of our known chemical processes. . . . The fact is, that bones, after having undergone a certain internal process of fermentation, ultimately contain about 2% of gelatine. As this is the only substance to which they can owe any fertilizing activity, they may be practically looked upon as valueless.

These were the opinions of 60 years ago! They were born of ignorance and were fostered by vanity and prejudice. Sixty years hence, what will our own successors think of our knowledge of the same subject? All generations produce some thinking men, and thus, 13 years after the publication of the article just quoted, that is to say in the year 1843, the light came! The Duke of Richmond was a practical and enthusiastic farmer; he made an exhaustive series of experiments on his soils with fresh and degelatinized bones. His results proved beyond doubt that they both owed their virtue, not to gelatine, or fatty matters, *but to their large percentage of phosphoric acid!* Other investigators—notably BOUSSINGAULT—having confirmed and elaborated the Duke's conclusions, there was soon such a run upon bones as to exhaust the rather limited supply. Attention was thus drawn to the deposits of mineral phosphates which had been already discovered

in several directions, and thence may be dated the development of phosphate mining as an industry, the pursuit of which has proved so remunerative to capital and labor.

Another writer well versed in this subject is Dr. R. A. F. PENROSE, Jr., whose valuable monograph entitled "The Nature and Origin of Deposits of Phosphates of Lime," was issued as Bulletin No. 46 of the United States Geological Survey. In discussing the office of phosphate of lime in organic life, he says:

It has been estimated that for each cow kept on a pasture through the summer there are carried off, in veal, butter and cheese, not less than 50 lbs. of phosphate of lime. Consequently it will be seen that phosphoric acid is one of the most important elements of plant food, and no soil can be productive which is destitute of it. The necessity of restoring phosphoric acid to an exhausted soil has been acknowledged from very ancient times, though the cause of its stimulating effect was unknown until a comparatively late date. In the days of the Romans the excrements of birds, from pigeon-houses and bird-cages, brought a high price, and EDRISI relates that the Arabians, as early as 1154 A. D., used the guano deposits found along their coast for agricultural purposes. GARCILAS DE LA VEGA (Comentarios Reales, lib. V, 1604) says that the Peruvians, in the twelfth century, used the guano beds on their islands as fertilizers. Of such importance did they esteem the material of these beds that the penalty of death was imposed by the early Incas on any one found killing the birds that made these precious deposits. It was not, however, until the early part of this century, when LIEBIG and others showed the important part played by phosphoric acid in vegetable life, that artificial phosphate manures came into use, and it is only in the last twenty years that the mining of natural phosphates with their conversion into superphosphates has assumed its present great and steadily increasing importance.

The remainder of this article, describing the principal commercial sources of phosphate of lime, we abstract from Dr. PENROSE's work. He classifies the chief minerals containing phosphate of lime in considerable amounts as follows:

- Mineral phosphates.
  - Apatites.
    - Fluor-apatites.
    - Chlor-apatites.
  - Phosphorites.
- Rock phosphates.
  - Amorphous nodular phosphates.
    - Loose nodules.
    - Cemented nodules or conglomerates.
  - Phosphatic limestone beds.
  - Guanos.
    - Soluble guanos.
    - Leached guanos.
  - Bone beds.

Mineral phosphates include all deposits of phosphate of lime which, besides having the other properties inherent in a true mineral, have a definite chemical composition, or at least show a strong tendency toward such properties and composition. Rock phosphates include those deposits which, having no definite chemical composition and lacking the homogeneous nature and other fixed characteristics of a true mineral, cannot be classed with mineral phospates.

APATITES OF CANADA.

Of the apatites, the most valuable deposits known are those which occur in Canada. There are two principal districts. One is in Ottawa County, Province of Quebec, covering an area about 15 to 25 miles wide, stretching from near the Ottawa River north about 60 miles. The other is a much larger district in Ontario, about 6,000 sq. miles in extent, including the counties of Leeds, Lanark, Frontenac, Addington and Renfrew, extending from near the St. Lawrence north nearly to the Ottawa River.

Dr. T. STERRY HUNT, whose study of these deposits has been very thorough considers them to be of purely mineral origin. Prof. J. W. DAWSON, however, holds that they are of animal origin. A paper by Dr. HUNT on these deposits will be found in the "Transactions of the American Institute of Mining Engineers," Vol. XII., pp. 459–468.

The highest grade of apatite shipped from Canada rarely averages over 85% of tribasic phosphate of lime, and none of the mines ship much which does not average at least 70%. Prices are based on the percentage of phosphate contained, and may be set at $17 to $20 per ton for 80% rock. In 1885 the production reached 23,908 tons, of which all but 1,500 tons came from the Quebec district.

EUROPEAN SOURCES OF PHOSPHATE.

The only other apatite deposits of commercial importance are those of Norway and Spain. The yearly product of the Norway deposits has never exceeded a few thousand tons. The percentage of phosphoric acid is much less than in the Canadian deposits, 30% to 40% being the average. Of late years other sources of high-grade phosphates have driven the Norway product about out of the market. Spain has produced even less apatite than Norway, and at present none is exported.

Phosphoritic deposits have been worked in Nassau, Prussia; in southwestern France, in Spain, and in small quantities in Amberg, Bavaria. In 1867 the total output of the Nassau mines was 30,000 tons, worth $5 to $8 per ton. Not much is now exported, but it is used in considerable quantities along the Rhine. The deposits of southwestern France were most productive from 1870 to 1875, when an average of 20,000 tons per annum was exported. The deposit was a small one, however, and the chief mines were soon exhausted. A few of the mines are still worked for local use.

Spain contains the most productive phosphate mines known. Lack of transportation facilities and political troubles have hindered their development; but they have nevertheless been a chief source of phosphate of lime for English fertilizer manufacturers.

The "amorphous nodular phosphates" are by far the most important commercial sources of phosphate of lime. The average production is given as 600,000 to 700,000 tons, of which in 1884 no less than 434,000 tons were mined in South Carolina.

A poor quality of phosphate is found in North Wales, but it is not now worked. England has large deposits of phosphates which have been worked for many years. The three counties of Bedford, Cambridge and Suffolk, in which are the principal mines, produced 250,000 tons in 1875, but had dwindled in 1881 to only 31,500 tons. Dr. PENROSE gives the following history of English rock phosphates:

The greensand of England has been used as a fertilizer for many generations. As early as 1790 it was considered so valuable as a soil stimulant that it was carried in carts sometimes for many miles all over the counties of Essex and Kent. Immense pits, dug in the greensand marl, concerning which there is no historic record, and which are now overgrown by large oaks and other forest trees, bear witness to the great value placed on this marl in bygone times. A remarkable example is seen at Worldham, where there is a large excavation 15 ft. deep, from which, once, thousands of tons of greensand were removed. But the heaps of phosphatic nodules which are often found near these pits, and which seem to have been thrown away as worthless, show that the value of this part of the bed was not known.

It was not until nearly the middle of this century that the agricultural value of these nodules was appreciated.

From that time on the use of the English phosphatic nodules became more and more extensive, until within the last few years the immense exports of phosphate of lime from South Carolina, the West Indies and other localities have thrown so much of that material on the market that the English deposits have become a source of minor importance.

According to O. FISHER, writing in 1873, the miners in Cambridge had to pay $700 per acre for the right to dig phosphate, and had to return the land to its original level condition and resoil it. With all this expense the average yield was only 300 tons per acre, which sold at $12 a ton; while in the South Carolina diggings the yield is 300 to 1,500 tons per acre, and it sold, at that time, for $8 a ton. The nodules in England were dug to the depth of 20 ft., but it did not pay to go any deeper.

Dr. C. U. SHEPARD, Jr., informs me that he visited the diggings at Whaddon, near Rowsley, in 1875. They were then working at the depth of 8 to 18 ft., all the surface beds having been exhausted. Sums from $500 to $1,250 per acre were paid for the right to take the rock, and the yields per acre were from 150 to 400 tons. The mining was done in open trenches. The phosphate rock was washed in circular horizontal tubes, and was kept moving by rakes worked by steam. The capacity was about 5 tons daily, and the cost of washing about 85 cts. a ton.

In Belgium phosphate deposits are found in the southern part of the kingdom which produced 85,000 tons in 1884, a gradual increase from a production of 3,850 tons in 1877.

In France phosphates are found in the central and in the northern part. The northern mines produced 60,000 tons in 1875.

Russia contains the greatest known area of phosphate deposits of the cretaceous age. The principal district is about 50,000,000 acres in extent. The phosphate lies at such a depth, however, that little of it can be profitably mined, and it is, moreover, of poor quality.

Phosphatic limestones have been found in Kentucky by Prof. N. S. SHALER containing about 32% of phosphoric acid. It is possible that the wonderful fertility of the soil in some districts is due to the decomposition of such limestone beds.

GUANOS.

As already stated, the author divides these into the two classes of soluble and leached guanos. The coast of Peru has been the chief source of soluble guano; but the richest deposits have been exhausted, and a comparatively small amount is now obtained. Leached guanos are chiefly found in the West Indies, where they are extensively mined. The author also discusses cave deposits and lacustrine deposits under the head of "Bone Beds." None of these occur with sufficient frequency or extent to be of much economic importance.

(To be continued.)

Railway Foreclosure Sales and Receiverships for Six Months.

The effect of the financial stringency of the present year upon new railway construction and upon the railway situation in general has been plainly evident to those who have studied the railway columns of ENGINEERING NEWS for the past six months. The serious falling off in new construction in the Eastern and Southern States, as shown by our construction maps of April 11 and June 13, is only an index of the condition of affairs in the other parts of the country. In this connection the following figures, taken from the *Railway Age* of July 4, showing the railway companies which have gone into the hands of receivers and those which have been sold under foreclosure during the first half of 1891, are interesting:

FORECLOSURE SALES FROM JAN. 1 TO JULY 1, 1891.

	Miles	Funded debt.	Capital stock.
Syracuse & Baldwinsville	7	$160,000	$60,000
Sedalia, Warsaw & Southern (N. G.)	42	338,000	330,000
Lake Erie Alliance & Southern	61	2,026,000	2,000,000
Day., Fort W. & Chic. (part N. G.)	261	5,550,000	15,000,000
Tonawanda Val. & Cuba (N. G.)	30	438,000	587,000
New Orleans & Gulf	65	1,000,000	241,000
Tavares, Orlando & Atlan.	32	*360,000	*300,000
Bedford & Bridgeport	49	6,600,000	600,000
Cin. & Southeast'n. (N. G.)	18	*180,000	*180,000
Kansas City & Southern	111	2,220,000	2,220,000
Texas Central	229	5,685,000	200,000
Chicago, Kansas & Neb.	1,471	26,000,000	27,698,000
Norfolk Southern	74	2,495,000	1,000,000
Covington & Macon	107	1,284,000	1,284,000
Meadville & Linesville	21	150,000	250,000
Erie & Genesee Valley (br. Erie Ry)	12	120,000	145,000
Total 16 roads	2,590	$54,496,000	$52,035,000
Total debt and stock			$106,531,000

*Partly estimated.

RECEIVERSHIPS ESTABLISHED FROM JAN. 1 TO JULY 1, 1891.

	Miles	Funded debt.	Capital stock.
Texas Western (N. G.)	53	*$636,000	*$636,000
Atlantic & Danville (part N. G.)	299	4,792,000	4,311,000
Bradford, Bordell & Kinzua (N. G.)	29	498,000	500,000
Marietta & North Georgia	244	3,835,000	1,560,000
Meadville & Linesville	21	150,000	200,000
Kentucky Union	94	2,500,000	*2,500,000
Penn., Po'keepsie & Boston	73	1,66[illegible],000	2,000,000
Charleston, Cin. & Chicago	175	8,340,000	6,567,000
San Gabriel Valley Rapid Transit (N. G.)	6	*60,000	*120,000
Georgia South'n. & Florida	286	3,420,000	4,275,000
Macon & Birmingham	97	*1,900,000	1,900,000
Macon & Atlantic	15	*300,000	*500,000
Baltimore & Eastern Shore	87	1,600,000	478,000
Carolina, Knoxville & Western	14	240,000	702,000
Louisville & St. Louis	17	*170,000	*170,000
St. Paul, Stillwater & Taylor's Falls	22	361,000	
Total 16 roads	1,512	$70,385,000	$25,819,000
Total bonds and stock			$56,204,000

*Partly estimated.

In addition to the above there were three other companies which had expended considerable money in surways and grading, whose roads were sold, and also three companies having partly graded lines which were placed in the hands of receivers.

Of the 2,590 miles of road sold at foreclosure, it will be seen from the table that 2,179 miles were owned by five companies. These five companies

also controlled $40,689,000 of the bonded debt and $46,392,000 of the capital stock, or over 81.7% of the total stock and bonded indebtedness of the 16 companies included. The same is true in a less degree of the companies placed in the hands of receivers. In this case we find 1,066 miles of the total 1,512 miles controlled by five companies (the Georgia Southern & Florida, the Macon & Birmingham and the Macon & Atlantic being controlled in the same interests are considered as one company). The aggregate stock and bonded indebtedness of these four companies is 71.6% of the total. One of the most interesting points brought out by the table is the location of the various lines. It is seen that a very large percentage of the mileage is included in the section of country lying south of latitude 38° and east of longitude 98°. Of the lines placed in the hands of receivers, eight or one half of the total number are included in the States south of the Ohio and east of the Mississippi rivers. These roads control 1,204 miles of the total 1,512 miles and aggregate over 83.5% of the total indebtedness of the 16 roads represented. Considered in connection with the tendency to "boom" railway construction in that section, of which we have before spoken, these figures are significant.

In comparing these totals with those for the year of 1890 the *Age* find that the probabilities are that the totals for 1891 will considerably exceed those of 1890. The companies which have become insolvent are, however, among the less important, and in many cases had but just begun operations.

It should be understood, however, that these figures have little significance as indexing the general prosperity or adversity of the railway system at large, and are even an unreliable guide to the real status of the roads concerned. Bankruptcies are often very far from meaning the financial ruin of the insolvent; and railway bankruptcies and receiverships do not always signify that the roads involved have not many causes of prosperity. Railroad wrecking, carried on for the purpose of squeezing out weak-kneed stockholders or scaling down the interest rates of unsuspecting bondholders, has been practiced in the past, and may be practiced again. Moreover, roads have been built for a great many other reasons than to earn profits for those who furnished the money for their construction. It is not impossible that some of the roads in the above table may belong to this class. At any rate to argue from the above statistics that railroad transportation is an unprofitable business, as some of the daily papers have been known to do, is reasoning of a very feeble sort.

Traffic on the Suez Canal.

The accompanying diagram, prepared from statistics given in *Industries*, illustrates the growth of the traffic and traffic receipts of the Suez Canal. The canal was opened Nov. 17, 1869, and in the remainder of that year 10 vessels, with an aggregate tonnage of 10,557 tons, passed through. While all

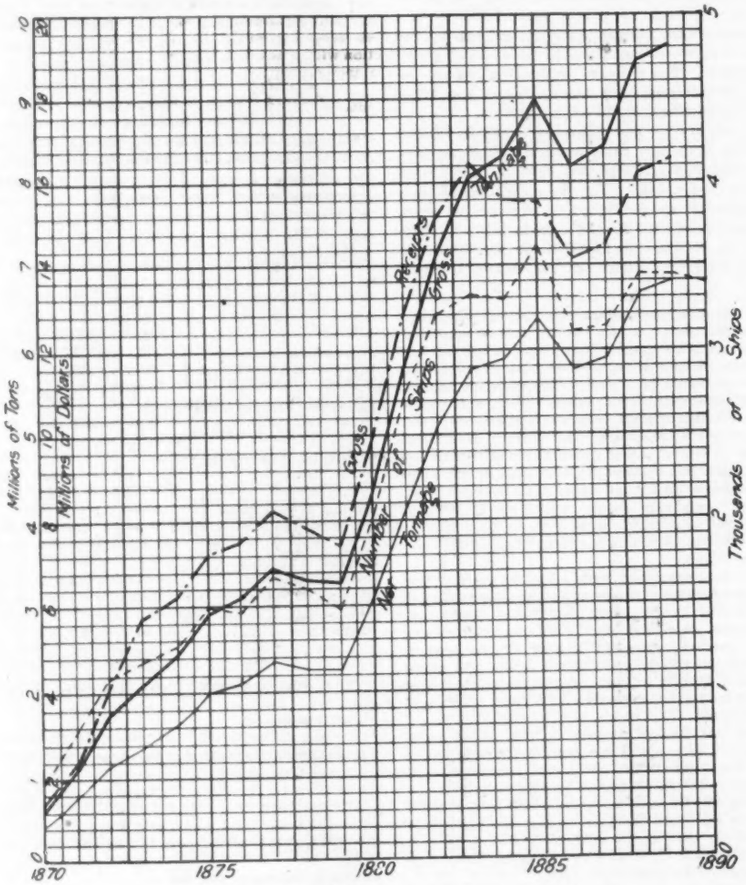

DIAGRAM OF TRAFFIC ON SUEZ CANAL.

the causes of the fluctuations in these lines are not at once evident, the rise that began in 1886 and is still continuing may be attributed largely to the introduction of electric lights. The number of vessels passing through the canal at night has increased from 395 in 1887 to 2,836 in 1890, and the average time of transit has been decreased from 33 hours 58 minutes to 22 hours 9 minutes, or very nearly one-third. The shortest time yet made was 14 hours 15 minutes in 1891.

The nationality of the ships passing in 1890 was as follows: British, 2,522; French, 171; German, 275; Dutch, 144; Italian, 87; Austrian, 55; Norwegian and Swedish, 43; Spanish, 32; various, 60; total 3,389

The Polar Level.

We understand, says *Engineering*, that a well-known firm of London opticians has long had in hand designs for the manufacture of an instrument for taking and plotting levels, termed the polar level by the engineer officer by whom the invention was made. This level belongs to the class of integrating machines, and may be regarded as analogous to the polar planimeter for measuring areas. It takes advantage of the property to be found in works on the differential calculus, that the radius vector tracing any curve varies its length in proportion to the length of arc multiplied by the cosine of the inclination of the tangent at every instant; or $dr = \cos \varphi \, ds$ mathematically speaking. Essentially the instrument consists of a pair of bicycle wheels (connected by framework), to run on the curve of the ground, supporting a sheet of paper, moving, as it goes, under an arm carrying a pencil, which represents the radius vector. The pole of this tracing arm is kept in a steady position with respect to the paper by a pendulum balanced for inertia; but the arm itself is by means of a cam adjusted to an angle as the line connecting the centers of the wheels gives the tangent of the curve of the ground at each moment. The integrating mechanism is a sliding wheel on a revolving cone, so that the motion of the pencil on the paper differentiates from the speed of the paper in proportion to the cosine of the angle between the instantaneous radius and the tangent. By putting a train of wheels in gear to impart a transverse movement to the paper the level will take and plot a section in which the vertical scale is exaggerated. An instrument which reduces leveling to merely wheeling a piece of mechanism about the size of a safety bicycle over the ground should be useful to engineers whose work lies in bad climates or in the more uncivilized countries of great and monotonous extent.

Across the Atlantic in Five Days.

(*From an English Correspondent.*)

A model of a vessel which it is claimed would be able to cross the Atlantic in five days is being shown at the British Royal Naval Exhibition in London, where it is attracting considerable attention. The model bears the notice, "Empress, ocean passenger steamer; speed, 23½ knots at sea," and is exhibited by Messrs. James & George Thomson, Ltd., of Clydebank, Glasgow, a well-known Scotch shipbuilding firm. The length of a full-size vessel built according to the model will be about 630 ft., total molded depth about 55 ft., and beam about 73 ft. These dimensions are said to exceed those of any vessel afloat or proposed, while the weight of the steamer would be greater than that of any battleship, notwithstanding the thick armor, heavy guns, etc. There are four funnels, arranged far apart, so that it may be assumed that there would be four boilers to each. Considering the beam of the vessel, it would be possible to install 20 boilers if they were arranged longitudinally in two rows.

In the *City of Paris* there are only 9 boilers, so that with 20 boilers there should be a good supply of steam for engines of double the power of those erected in the former. The engine coamings also suggest the idea that it is intended to have two engines driving each propeller, giving four complete sets of engines with a total indicated horse power of from 30,000 to 45,000 HP. The makers of this model are not prepared to give much information concerning the engines, this being mainly due to the competition among shipbuilders to have the honor of building the new "greyhounds." The vessel has twin screws of over 20 ft. diameter. Each has four blades and is placed on one side of the balanced rudder.

Regarding the passenger accommodation, there will be state rooms for 700 first-class passengers, 300 of the second class, and room for about 400 emigrants. Instead of being forward, as in the *City of Paris*, the main dining saloon will be aft, while the smoke-room will be forward. The plating of the vessel is carried right up to the promenade deck, instead of there being a clear space below it, as in the Inman steamers, and this causes the vessel to appear deeper. There is practically no rigging, as the two small masts will only be used for signaling purposes. On the promenade deck 10 machine guns are mounted so that the vessel may be used as an armed cruiser.

With a speed of 23½ knots, corresponding to about 27 statute miles an hour, a five days' passage could be made. Crossing the Atlantic *via* Cape Race, the speed for a five-days' run would be 22.9 knots, and just over 23 knots if the Atlantic were crossed north of the Virgins. The route taken in the summer is a little south of the Virgins, and to cover it in 5 days implies a speed of 23½ knots, so that the proposed vessel would have nearly one-third of a knot per hour to spare.

THE PIKE'S PEAK RY. is in operation, the first regular train having reached the top, 14,147 ft. above sea level, on June 30.

WORK HAS BEEN STOPPED ON THE CHIGNECTO SHIP RAILWAY, says a dispatch from Halifax, of July 6. About $3,000,000 have been spent in construction, and the company is said to be cramped for funds.

THE PANAMA CANAL INVESTIGATION, now pending in Paris, promises to yield some astonishing results, as the intention seems to be to make the inquiry thorough. There is still some power in the canal clique and every effort is being made to shut off the coming trial. But one of the most reputable French financial papers, the *Economiste Francais*, denounces the Panama affair as "the greatest financial scandal of the nineteenth century," and demands the immediate trial of those responsible for absorbing over $200,000,000, snatched from the savings of small capitalists. The other charges made are straightforward and specific and, if pushed, the material is at hand for one of the greatest trials of modern times.

AN OIL BARGE is ready to be launched at the yard of the American Steel Barge Co., at West Superior, Wis. It is built for the Standard Oil Co., and is to be delivered at New York, to be used in the coastwise trade. The barge is 125 ft. long, 10 ft. deep and 30 ft. beam, and in general is modeled after the "whaleback" type of vessel. In the hull are three tanks, occupying the full depth and beam of the barge and 66 ft. of the total length. The end spaces are empty, and give buoyancy to the hull, as there are no other air spaces, as in the whaleback proper. The tanks will hold 500,000 galls. of oil. A low, center dome runs about two-thirds of the length of the barge on the upper deck, and there is a cabin in the stern. The barge will be towed.

TO DETERMINE THE EARTH'S FLATNESS Prof. T. C. MENDENHALL, Chief of the U. S. Coast Survey, is now on the Pacific Coast making some delicate experiments. The exact amount of the flattening of the earth at the poles is not yet known, for our territory at least, and the present attempt is to observe the differences in the force of gravity as measured by the beat of an exceedingly delicate pendulum. Observations have already been made in Washington, D. C., San Francisco and Sitka, in Alaska. Other points are now being noted.

In an article on this subject in the Seattle *Post-Intelligencer* the apparatus is thus described as being then used in Seattle:

The instruments are very delicate, and are so exact that it is possible to determine the time of a pendulum beat down to the 500,000th part of a second. The pendulum itself, made of aluminum and copper, is hung on agate knife-bearings in an airtight brass box. The air is exhausted from this so that the pendulum may have to overcome no resistance. Experiments are made with pendulums of three different lengths, which of course beat in different time. The temperature of the pendulums is also carefully noted, so that the change in their length from expansion by heat and the consequent change in time of vibration may be allowed for.

Each pendulum carries a mirror on which the light is thrown through a small window in the brass box. There is a flash, flash, flash as the pendulum swings. A small telescope is used for watching the flashes. In this telescope the field of vision is opened and closed every second by a shutter connected through an electric circuit with a chronometer. The pendulum swings a little oftener than once a second, and so, while the light from the swinging mirror sometimes flashes into the telescope at the instant the shutter is opened, the opening of the shutter and the flashing of the mirror do not generally coincide. The time of vibration can be determined with great exactness by noting the period of coincidence The observations are being continued night and day.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Pennsylvania.—Surveys are being made for an extension of the Chestnut Hill Branch to a connection with the Trenton Cut-off recently completed from Norristown, Pa., to Morristown, N. J.

New York, New Haven & Hartford.—This company expects to have the four-track line between South Norwalk and Bridgeport, Conn., 14 miles, completed by Oct. 1. The two new tracks are already completed, and work is now in progress lowering the two old tracks to the same level. The completion of this section will give the company 23 miles of four-track road. The company will continue this work until the entire New York Division is four-tracked.

Portland & Rumford Falls.—This company has leased the Rumford Falls & Buckfield R. R. and will hereafter operate the same. The officers are: President, Hugh J. Chisholm; Superintendent, L. L. Lincoln; Treasurer, R. C. Bradford.

Bristol.—The people along the route of this partly graded line from New Haven to Bristol, Vt., are taking steps toward building the road by local subscription. A local paper states that the prospects are good for the early commencement of work.

Central Vermont.—The Rutland R. R. Co will issue $3,500,000 of bonds to provide for retiring a portion of the old first and second mortgage bonds and for making improvements.

Beech Creek.—It is stated that work will soon begin upon an extension of this road from Keenmore to Mark's Mills, Cambria Co., Pa.

Dutchess County.—The subscription to the $300,000 of bonds of this company has been completed, and it is probable that work will soon be resumed upon its partly graded roadbed. The road is projected to run from Poughkeepsie to Hopewell Station, N. Y., 12 miles. D. N. Stanton, of Yonkers, N. Y., is interested.

Wilkesbarre & Western.—At a recent meeting of the stockholders it was voted to construct only the portion of this road already completed. This action was taken to save the charter of the company, which requires the road to be completed this month.

Canadian Pacific.—The Canadian Pacific and Boston & Maine Ry. companies have practically agreed upon a plan whereby the distance between Boston and Montreal will be materially shortened. The Canadian Pacific is to build from St. Constant to Rouse's Point, connecting there with the St. Johnsbury & Lake Champlain R. R., which is owned by the Boston & Maine, and the Boston & Maine is to build two short cuts to save distance, one from Hardwick, on the St. Johnsbury & Lake Champlain, to Barnet and Wells River, on the Passumpsic Division of the Boston & Maine, and the other from Firlee, on the same division, to Canaan. The distance saved will be about 20 miles.

Projects and Surveys.

Maine Shore Line.—At a recent meeting of the directors the President was authorized to enter into a contract for the building of this railway. The road is projected to run from Sullivan on the Maine Central R. R. to Calais, Me., with a branch from South Charlotte to Eastport, Me., a total distance of about 125 miles. L. G. Downes, Machias, Me., is President.

Toledo & Chicago Bee Line.—It is stated that the negotiations are now completed for the sale of the franchises of the Toledo & Western R. R. to the syndicate headed by Donald McLean, of New York City, which proposes to build the road. It is projected to run from Toledo, O. to Chicago.

Laurel & Roaring Point.—The projectors will soon open books for the subscription of the stock of this company. The road is projected to run from Laurel, Del., to Tyaskin, Md., 25 miles.

Plymouth & Bournedale.—A new survey will be made for this proposed railway from Plymouth to Bournedale, Mass., by Chas. M. Thompson, with the view of shortening the line.

Bangor & Aroostook.—A second party of engineers will soon be put at work on the preliminary survey of this Maine road. The first party is now locating the first section from Brownville north, with President A. A. Burleigh, Houlton, Me.

Mapleton & Rocky Run.—Chartered in Pennsylvania to build a railway from Mapleton Station, on the Pennsylvania R. R., south to the farm of J. M. Wakefield, in Hours Valley, a distance of one mile. Capital stock, $10,000. President, Clifton W. Phillips, Allegheny City, Pa.

SOUTHERN.—Existing Roads.

Nashville & Knoxville.—The contract has been let for a 10-mile extension of this road from Cookeville to Standing Stone, Tenn. The work will be quite difficult.

Charleston, Sumter & Northern.—This road has been opened for traffic from Sumter to Bennettsville, S. C.

Chesapeake & Ohio.—The grading has been completed on the branch from Covington to Warm Springs, Va., and tracklaying will be commenced at once.

West Virginia, Pineville & Tennessee.—An official of this road is quoted as saying that 15 or 20 miles additional of this Kentucky railway would be completed during the coming fall and spring. The company now operates 2 miles of railway at Pineville, Tenn.

Cincinnati & Kentucky Southern.—H. D. Emerson, of 99 West Fourth St., Cincinnati, O., writes that this company has purchased the Cincinnati & Green River Railway, and will extend it from Yosemite toward Columbia, Ky., about 60 miles. Sixteen miles from Yosemite, Ky., southwest have been surveyed and the right of way secured. The route is through a very rough country.

Nashville, Chattanooga & St. Louis.—The capital stock of this company has been increased $3,331,000.

Norfolk & Western.—The surveys for the line from Port Royal, Va., to Washington, D. C., have been completed.

Gainesville, Rocky Point & Micanopy.—This railway from Gainesville to Micanopy, Fla., will be 12 miles long. Construction is now in progress. The company will place an order for 12 miles of steel rails at once. Address James M. Graham, Gainesville, Fla., Vice-President.

Projects and Surveys.

Bennettsville & Hamlet.—A company has been organized to build a railway from Bennettsville, S. C., to Hamlet, N. C., 21 miles. The officers are: President, A. A. Howlett; Vice-President, M. L. Dolby; Secretary, J. K. Livingston, and Chief Engineer, G. W. Earle. Surveys have been finished.

Chesterfield & Kershaw.—This company, whose organization was noted last week, will build a railway from Cheraw to Camden, S. C. About $50,000 of stock has been already subscribed. J. W. McKay, Cheraw, S. C., President.

Chesterfield & Lancaster.—W. A. Evans, of Hornsboro, S. C., has been elected President of this company. The road is projected to run from Cheraw to Lancaster, S. C. About $51,000 of the stock has been subscribed.

Kennesaw Park Ry. & Improvement Co.—Application will be made to the next Georgia State Legislature for an act incorporating a company by this name.

Charleston, Glendennin & Southern.—A special election will be held in Kanawha Co., W. Va., Aug. 1, to vote upon a subscription of $100,000 of the stock of this company. The road is to run from Charleston, W. Va., to Sutton, W. Va., along the valley of the Elk River.

Tennessee River & Sequachee.—A company by this name is to be incorporated to build a railway from the Tennessee River, via Sequachee, to the top of Cumberland Mt., 8 miles, with a branch to Dixon's Cove, 2 miles. Surveys are being made by John M. Blackburn.

Lake Jessup, Indian River & Atlantic.—The preliminary survey has been completed for this railway from Lake Jessup to Coquina, Fla., 45 miles, and the line is now being located. J. O. Fries is the engineer in charge.

Norfolk, Wilmington & Charleston.—It is stated that engineers will soon be put in the field to make a preliminary survey of this line. The road is projected to run from Charleston, S. C., to Norfolk, Va. The general offices are at 212 South Third St., Philadelphia.

Boynton & National Park.—Organized in Tennessee to build a railway from Chattanooga to Harrison, Tenn., passing through Tyner's Station, Tenn., Graysville, Boynton and Chickamauga, Ga. Among those interested are J. M. Suttor, of Chattanooga, Tenn., and Cutler Smith, of Boynton, Ga.

Chicago, Mobile & Gulf Port.—Books of subscription to the capital stock of this company have been opened. The road is to run from Mobile to Mobile Point. Daniel Williams and Henry C. MacEwen, of Mobile, Ala., are among the incorporators.

Charleston & Northern.—A movement is being made toward the construction of this railway from Charleston, S. C., to Camden, S. C., 50 miles. The Taylor Land & Improvement Co. is at the head of the movement.

Pensacola & Meridian.—It is stated that $78,500 of the capital stock of this company has been subscribed. It proposes to build a railway from Pensacola, Fla., to Meridian, Miss., 160 miles. J. M. Carter, of Pensacola, Fla., is interested.

Lenoir City, Montvale & Gulf Port.—A correspondent writes us that this company has been chartered in Tennessee to build a railway from Lenoir City, Tenn., via McGehee's Station, Montvale Springs, and Sevierville, Tenn., to Paint Rock, N. C. The route is through a rich timber and mineral country. Among the incorporators are Henry E. Colton and Edward T. Sanford, of Knoxville, Tenn.

Arcadia, Gulf Coast & Lakeland.—We have obtained the following from the prospectus of this company recently issued:

This road will run from Lakeland, Fla., to Boca Grande, on the Gulf of Mexico, with a branch to Tampa Bay, a total distance of 200 miles. The route is through the phosphate lands of southwestern Florida, and it is expected that a large business will be obtained in the shipment of phosphate. The State of Florida has granted 3,840 acres of land for each mile of road, and in addition the company holds deeds of lands estimated to be worth $1,500,000. The company is now marketing 5,000 shares of stock. Anthony Peters, 88 Lincoln St., Boston, Mass., President.

NORTHWEST.—Existing Roads.

Itasca Lumber Co.—A press dispatch from Grand Rapids, Minn., says:

A large crew of workmen are here from Minneapolis to begin the work of the Itasca Lumber Co. Railway, which is starting just west of this place, in the Rainy River direction. It is proposed to rush the work and complete about 20 miles this season. An engineer's crew from Saginaw, Mich., has arrived to locate another line, also running north and south in the Swan River region. It will be about 26 miles long, and is owned by A. W. Wright & Co., of Saginaw and Bay City, but will be operated by the Duluth & Winnipeg R. R Co.

Minneapolis, St. Paul & Sault Ste. Marie.—An effort is being made by the citizens of Medford, Wis., to induce this company to build an extension to that place about 30 miles long.

Projects and Surveys.

Wisconsin Midland.—Dana C. Lamb, Secretary, Fond La duc, Wis., writes us that this company expects to let

the contracts for building 30 miles of its line this summer.

Marion & Du Quoin.—A correspondent writes us that this road is projected to run from Marion to Du Quoin Ill. The surveys have been completed and a very favorable line secured. All of the right of way has been granted gratis. The line is backed by the Illinois Central R. R. Co. and its principal business will be the coal traffic. James Dennis is Chief Engineer.

Red Lake & Western.—H. E. Ives, of Crookston, Minn., writes us that the preliminary survey for this road will begin some time in August, and that the route will be located as soon after as possible.

Litchfield Belt.—Chartered in Illinois to build a belt line transfer railway at Litchfield, Ill. Among the incorporators are: H. H. Beach and Daniel Davis, of Litchfield, Ill., and L. C. Haines, of St. Louis, Mo.

SOUTHWEST.—Existing Roads.

Fort Smith, Paris & Dardanelle.—At the regular annual meeting of the stockholders and directors of this company, held at Ft. Smith, Ark., June 20, 1891, the following directors and officers were elected for the ensuing year: H. W. Bush, P. D. Peters, J. W. Bush, J. W. North, Wm. M. Cravens, Thos. Boles, J. H. Carnell, directors; H. W. Bush, President; Thos. Boles, Vice-President; P. D. Peters, Secretary and General Superintendent; J. W. Bush, Treasurer; Wm. M. Cravens, Attorney.

Missouri Pacific.—The engineers have nearly completed the survey for the proposed Kansas & Arkansas Valley Ry. extension from Wagoner, Ind. Ter., to Denison, Tex.

Kansas City, Watkins & Gulf.—A preliminary survey for the proposed extension from Alexandria, La., north 50 miles has been completed by W. A. Darling, Assistant Engineer. About one-third of the tracklaying has been finished between Lake Charles and Alexandria, La.

San Antonio & Aransas Pass.—About 150 men are at work on the line from Lexington to Lott. A large quantity of material has arrived and tracklaying will soon begin.

Louisiana, Arkansas & Missouri.—President H. M. Hoyt is quoted as saying that this line would be extended from Delhi, La., via Harrissonburg to Alexandria, Va. Work is now in progress from Delhi, La., north to Tripp, Ark.

Projects and Surveys.

Richmond & Rocky Comfort.—Chartered in Arkansas to build a railway from Kellar, Ark., via Richmond to Rocky Comfort, Ark., 20 miles. Among the incorporators are: E. L. Hamilton and A. R. Morris.

ROCKY MT. AND PACIFIC.—Existing Roads.

Atchison, Topeka & Santa Fé.—This company has placed engineers in the field to survey an extension of the Colorado Midland R. R. to Southern California.

Southern Pacific.—The people along the route of the proposed coast line extension have succeeded in securing nearly all of the right of way required by the company before beginning construction, and it is probable that steps will soon be taken toward constructing the road. The line will run from Santa Margareta to Ellwood, Cal.

Northern Pacific.—About 10 miles of track have been laid on the line from Chehalis, Wash., to South Bend.

Tintic Range.—Geo. Goss, of Salt Lake City, Utah, Chief Engineer, writes as follows:

The contracts have been let for grading and bridging this Utah railway. The line is to run from Springville, Utah, on the Rio Grande Western Ry., via Spanish Fork, Payson and Goshen, to Tintic, Utah, about 48 miles. About 15 miles will be heavy mountain work and the remainder will be light. The right of way has been secured. The principal business of the road will be in ore, mineral supplies and general merchandise. D. C. Dodge, of Salt Lake City, Utah, is President.

Projects and Surveys.

Mt. Angel & Scott's Mills.—A project is on foot to build a railway from Mount Angel to Scott's Mills, Ore., 7 miles. R. H. Scott, of Scott's Mills, Ore., is at the head of the enterprise.

San Joaquin Valley.—This company has let the contract for building 25 miles of its line from Fresno, Cal., to timber lands in the eastern part of Fresno Co., to Fitzgerald Bros., of San Francisco, Cal.

Lake Chelan R. R. & Navigation Co.—This company has been chartered in Washington with Robert Law, of Chicago, as President. The purpose of the company is to open a line of transportation to rich mines recently discovered near the summit of the Cascade Mountains. Lake Chelan is the largest body of water in Washington. Its mouth is within three miles of the Columbia River, and it extends for 70 miles into Cascade Mountains.

Great Western.—This company has been chartered in Utah, with the following officers: President, J. H. Bacon; Vice-President, Witcher Jones; Secretary, F. L. Holland, and Treasurer, H. M. Bacon, all of Salt Lake City, Utah. It proposes to build the line of railway from Salt Lake City to the mining regions of Deep Creek, with a branch to Dugway, Utah, a total distance of 202 miles.

CITY TRANSIT.

Electric Railways.—New lines or extensions are reported as possible in the following places: Richmond, Va., address the Richmond Railway & Electric Co. La Port, Ill.; East St. Louis, Ill., address the East St. Louis Electric Street Ry. Co.; Middleboro, Mass.; Salem, O.; Almeda, Cal., address T. Meetz.

Winthrop, Mass.—The Boston & Revere Electric Ry. Co., has, it is said, received permission to operate a trolley road in this town.

North Andover, Mass.—The Merrimac Valley Street Ry. will probably be operated soon by electricity, the necessary permission having been recently obtained.

Milton, N. Y.—I. B. Whitcomb & Co., of New York, have been granted a franchise to construct an 8-mile line to Ballston Spa.

Canandaigua, N. Y.—The Canandaigua Street R. R. Co. is reported to be considering the adoption of electricity.

Pelham, N. Y.—It is reported that the Westchester Electric R. R. Co. will build a line here.

Pittsburg, Pa.—The Duquesne Traction Co. has, it is reported, decided to adopt the triple motor system. The motors will be so placed that 2 of 15 HP. each will be placed at one end of the car and the third at the other end. The 30 HP. developed at one end will be sufficient to climb the steepest grade.

Augusta, Ga.—The North Augusta Land Co. will, it is said, begin construction on a 3-mile line.

Toledo, O.—It is reported that a belt line will be built to connect all the electric lines in the city. An ordinance has been introduced in the Council which, if passed, will give the Calumet Street Ry. Co. control of many of the important streets south of 87th St. The franchise is to run 20 years, and overhead trolleys and a 5-ct. fare are made obligatory.

Chicago, Ill.—An exchange states that the South Chicago City Ry. Co. has been granted permission to extend its lines and change its motive power from horses to electricity.

Mattoon, Ill.—It is reported that $300,000 has been subscribed for the line to Charleston.

Houston, Tex.—The Houston City Street R. R. Co. will probably equip 10 miles of line with electric appliances this year.

Horse Railways.—New lines or extensions are reported as probable in the following places: Chicago, Ill., address the West Chicago Street Ry. Co.; Cloverport, Ky.; Green Cove Springs, Fla., address H. E. Bemis; Anniston, Ala., address J. H. Savage; Brooklyn, N. Y., address the Brooklyn City R. R. Co.; Gilmer, Tex., address J. S. Barnwell.

Elevated Railway.—*Brooklyn, N. Y.*—The General Term of the Supreme Court has granted the motion of Wingate & Cullen, in behalf of the Seaside & Brooklyn Bridge Elevated Railroad Co., to confirm the report of the commission appointed to determine whether the proposed road should be built. The report of the committee was favorable and pointed out three routes for construction. When completed the line will practically be an extension of the Union elevated system.

Cable Railway.—*Baltimore, Md.*—The directors of the Baltimore City Passenger Ry. Co. have chosen A. N. Connett as Chief Engineer of the proposed cable construction and have voted to begin work as soon as the plans are prepared.

Dummy Railway.—*Waco, Tex.*—It is reported that the Waco line will be extended to Robinson.

New Companies.—Waynesboro (Va.) Street Railway & Water Co. North Chicago Elevated Ry. Co., Chicago, Ill.; capital stock, $10,000,000; incorporators, W. F. Cronin, E. Childs, F. M. Charlton. Birmingham, Knoxville & Allentown Traction Co., Pittsburg, Pa.; capital stock, $1,000,000; incorporators, C. Ford Stevens, H. Sellers McKee, J. A. Chambers. Beaver Valley Traction Co., Beaver Falls, Pa.; capital stock, $300,000; incorporators, L. P. Stone, J. A. Elliot, T. P. Simpson. Fort Worth, Tex., Consolidated R. R. Co.; capital stock, $500,000, Electric Street Railway Co., Columbus, O.; capital stock, $100,000; incorporators, J. W. Gaulbert, H. M. Littell, J. M. Doherty, and others. Waldo Street Ry. Co., Belfast, Me.; capital stock, $500,000. City & Suburban Ry. Co. Portland, Ore.; capital stock, $1,000,000.

HIGHWAYS.

Massachusetts.—The contract for 15,000 sq. yds. of macadamizing near Lenox has been let to Connolly Bros., of Beverly Farms. Mr. Bacot, of New York, is the engineer. The cost will be about $20,000.

New York.—It is proposed to build a pike road along the shore of Lake George to the Sagamore Hotel, at a cost of about $15,000.

Ohio.—Polk Township, in Crawford Co., has let contracts for 6 miles of pike road at $21,000, and has sold $25,000 highway bonds. The roads will be 25 ft. wide, 12 ft. being of earth and 12 ft. of limestone, covered with vegra.

Arizona.—A road from Tempe to Globe, over the Sus picion Mountains, is proposed. The grading is estimated at $25,000. The distance is 90 miles.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Niagara, Ont.*—The bill incorporating the Ontario & New York Bridge Co., with power to build a bridge across the Niagara River, has passed the Parliamentary Committee of the Canadian Parliament.

Marlow, N. H.—An iron bridge will be built over the Ashuelot River at this place.

Bourne, Mass.—This township has voted in favor of building an iron bridge over Cohasset Narrows, Buzzard's Bay, and it is probable that the County Commissioners will soon take steps toward its construction.

Willimansett, Conn.—The Hampden County Commissioners will receive bids until July 14 for building the superstructure of an iron bridge over the Connecticut River. Leonard Clark, Board of Commissioners, Hampden Co., Mass.

Lancaster, O.—The Fairfield County Commissioners will receive bids until July 24 for constructing two bridges, 70-ft. span, 24-ft. roadway, and one 60-ft. span 24-ft. roadway, at this place. A. D. Friesner, President Board County Commissioners, Fairfield Co., O.

Lexington, Va.—The Lexington Development Co. will soon ask bids for building an iron bridge at this place.

McMinnville, Tenn.—Bids will be received until July 24 for building a 155 ft.-span highway bridge at this place. W. G. Kirkpatrick, Room 4, Berry Block, Nashville, Tenn.

Dallas, Tex.—Bids will soon be asked for constructing a bridge to cost $20,000 at this place. Address the Mayor.

Panna Maria, Tex.—An iron and steel bridge will be built over the San Antonio River at this point.

Ridelleville, Tex.—An iron and steel bridge will be built over the Echto River at this place.

Tunnels.—Application will be made to the coming session of the Georgia Legislature to incorporate the Atlantic Railway & Terminal Co. and to authorize that corporation to construct a railway tunnel to connect the eastern and western sides of the city of Savannah. D. C. Purse is one of the chief promoters of the project and can give particulars.

Work will be resumed on the tunnel under the Jackson River being built by the West Chicago St. R. R. Tunnel Co. Downey & Fitzsimons are the contractors.

WATER-WORKS.

NEW ENGLAND.

Farmington, Me.—The Farmington Water Co. has been incorporated; capital stock, $50,000.

Freeport, Me.—The Freeport Water Co. has been organized with a capital stock of $50,000, with E. B. Mallett Jr., President, and W. H. Soule, Treasurer.

Gorham and Standish, Me.—The Standish Water & Construction Co., of Portland, has been incorporated to supply these and other places.

Rutland, Vt.—Bids for material and labor for a 16-in. cast-iron supply main 3¼ miles long will be received by the Water Committee, G. E. Royce, Chairman, until July 13.

Lyndon Centre, Vt.—New works are projected.

Foxborough, Mass.—The district has voted $75,000 of 4% 30-year bonds for works. G. F. Williams is Clerk and F. L. Fuller Engineer.

Hanover, Mass.—The Hanover Water Co. has been incorporated by J. Dwelley, L. Phillips and H. H. Platt, with a capital stock limited to $60,000.

Haverhill, Mass.—In July the Council has passed in concurrence an order for the purchase of the works of the Haverhill Aqueduct, and the Mayor has been authorized to petition the Supreme Court to appoint appraisers to fix the price to be paid for the property.

Lowell, Mass.—The Water Board have voted to ask the Council to appropriate $60,000 for the introduction of a Jewell filtering system.

Lynn, Mass.—The Board has been authorized to extend a 20-in. main through 6 streets.

Westport, Mass.—The cottagers have organized a company with a capital of $2,000. Water will be pumped from a driven well to a reservoir. Pipe is being laid. E. S. Brown, Fall River, is President, and A. Manchester, Adamsville, R. I., Treasurer.

Apponaug, R. I.—Water will be introduced from the mains of the East Greenwich Water Supply Co.

New Britain, Conn.—P. M. Blake, Hyde Park, Mass., will report on increased storage.

Wethersfield, Conn.—A supply from the Hartford Works is under consideration.

MIDDLE.

Livingston Manor, N. Y.—Charles H. Smith, Middletown, is making surveys for a reservoir here.

Jamestown, N. Y.—The *News* is in favor of building city works. The present works were built in 1882 by a company.

Mayville, N. Y.—Works are still being discussed. G. E. Leet is Secretary of the Water Commissioners.

Potsdam, N. Y.—About 2,600 ft. of pipe have been ordered laid.

Syracuse, N. Y.—Preliminary work for the new supply is in progress. Howard Sole has been appointed consulting engineer.

Clinton, N. J.—The Clinton Illuminating & Water Co. has been incorporated; $10,000.

Lancaster, Pa.—City Regulator A. A. Herr has reported on the cost of a 15,000,000 or 20,000,000-gall. reservoir. Action is expected July 14.

Reading, Pa.—The vote on a $150,000 loan for new mains will be taken July 15.

York, Pa.—The York Water Co. has voted to increase its capital stock $50,000.

SOUTHERN

Pulaski, Va.—The Land & Improvement Co. has contracted with the Gilmorgan Co., Lynchburg, for pipe.

Waynesborough, Va.—The Waynesborough Street Railway, Light & Water Co. has been incorporated by W. W. Fishburn, R. T. Wright and W. B. Gallagher; capital, $100,000. It it reported that 3 miles of 8 to 4 in. pipe will be wanted.

Wytheville, Va.—It is reported that the town will put in a 5-mile supply main from Springs on Lick Mountain.

Mannington, W. Va.—J. M. Blackshear is one of the incorporators of the Mannington Water Supply Co.

Fayetteville, N. C.—The following is from J. D. McNeill, Chairman Water-Works Committee:

April 1 the franchise was granted to the National Water Supply and Guarantee Co., on condition that works be completed by Dec. 31. It is expected that construction will be started at once. Water power will be used for pumping. There will be 7 miles of mains and 60 hydrants.

The President of the above company was inadvertently given last week as D. F. Wemyss. J. M. Gardiner, Ashland, Ky., is General Manager, and the company's principal place of business is in Ashland.

Citra, Fla.—A small duplex pump, 10 HP. boiler and 800 ft. of 3-in. galvanized iron pipe are wanted by E. L. Waterman.

Dothen, Ala.—The issuance of bonds for works will be voted on.

Pratt Mines, Ala.—A franchise has been granted to M. Crennen and others. Water will be pumped to a reservoir.

Chattanooga, Tenn.—The *Times* states that plans are being made for an experimental filter, 12 ft. in diameter by 100 ft. long, to be placed in the river.

Harriman, Tenn.—J. P. Superkrop, Engineer, informs us that the East Tennessee Land Co. wishes to correspond with parties desiring to construct works.

Union City, Tenn.—S. Waddell informs us that plans are being made and that bids will soon be asked for a light and water plant to cost not over $60,000. Wells, a pump and stand-pipe are proposed. W. G. Alexander is Chairman of Water Board. Population, 4,000.

West Knoxville, Tenn.—An ordinance has been passed granting a franchise to the McIntyre Co. The Mayor and Recorder have been authorized to indorse the charter of the Beaumont-Lonsdale water at the request of Mr. McIntyre.

Coverport, Ky.—A charter has been granted for works here.

Parkland, Ky.—We are informed that an attempt is being made to obtain a supply from Louisville. The result is doubtful. In case this cannot be effected there is talk of organizing a company.

NORTH CENTRAL.

Bellaire, O.—H. G. Wilson, General Manager, has asked for bids for a set of new pumps and other machinery to take the place of the machinery now in use. General improvements will be made to the works.

Bridgeport, O.—The following is from H. Crawford:

Contracts for works were let June 29. The supply will be from the Martin's Ferry works. Moore & Staub, Bridgeport, have the contract for the reservoir, and Hibbard & Sons, Wheeling, W. Va., have the contract for all other parts of the work. Estimated cost, $25,000. Bonds will be sold during July. Population, 3 650. Engineers, Dunham & Paine, New York.

Massillon, O.—Plans and estimates are to be made by Dunham & Paine, New York, for the removal of the pumping station to a new source of supply from artesian wells.

Napoleon, O.—J. C. Sand informs us that the people will vote for or against works July 30.

Niles, O.—The highest and lowest bids recently received for complete works, exclusive of developing a supply, were from G. W. Byers, Kansas City, and Thomas Connell, Youngstown, $54,370 and $48,908, respectively. J. W. Newcomer, Cleveland, offered to develop 700 galls. of water per minute for $4,335, or 500 galls. for $3,438. J. W. Nier, St. Louis, is Consulting and J. B. Strawn, Salem, O., Designing Engineer.

Wapakoneta, O.—We are informed that a vote will be taken July 17 on the granting of a franchise. J. Myers is Clerk.

Wellsten, O.—J. M. Ervin, Mayor, informs us that the works, for which bids are asked, will include a 24 × 75-ft. stand-pipe and 5 to 7 miles of mains.

Brookfield, Ind.—Bids will be received until July 23 for works complete, including a 1,000,000-gall. compound duplex pump, a reservoir, and about 425 tons of pipe. W. E. Schoonover is Clerk of Trustees.

Linwood, Ind.—Bids will be received until July 15 for a franchise. Q. A. Armfield is City Clerk.

Noblesville, Ind.—Bids are asked until July 22. See advertising columns.

Bay City, Mich.—Bids are wanted for $100,000 water bonds. The bonds were recently sold to Adams, Blodgett & Co., Boston, who afterward refused to take them.

Grand Rapids, Mich.—F. A. Twamley, Secretary, informs us that a $300,000 loan has been voted for a new supply from driven wells and for 23 miles of new mains.

Plymouth, Mich.—We are informed that contracts for works will soon be let. The system will be direct pumping, with a supply from springs or wells. W. F. Markham is Chairman.

Flanagan, Ill.—Bids for complete works will be received by the Village Trustees until July 21. E. Litchfield is President and H. F. Mette Village Clerk.

Springfield, Ill.—A new 30-in. main from the river to the reservoir is projected.

Wilmette, Ill.—C. H. Drury, Village Clerk, informs us that an engineer has been employed to make plans for works, but nothing further has been done.

Waupaca, Wis.—W. H. Holmes, City Clerk, has sent the following information:

J. H. Woodworth and R. N. Roberts have just accepted a franchise and will probably form a company to build works, taking the supply from a pond within the village. There will be two 1,500,000-gall. pumps, and a stand pipe 75 ft. high and not less than 10 ft. in diameter. Construction must be started by Sept. 1.

NORTHWESTERN.

Mapleton, Ia.—We are informed that a vote will soon be taken on building works. It is proposed to pump from wells to a tank.

Paullina, Ia.—We are informed that the people have voted in favor of works, but bonds have not yet been voted or other steps taken.

Perry, Ia.—A. L. Strang & Sons, Omaha, Neb., are the contractors for works here.

West Union, Ia.—The following is from Frank Hobson, Chief Fire Department:

The village has voted to build works estimated to cost $16,500. There will probably be a stand pipe and 2½ miles of mains. Population, 1,800.

Duluth, Minn.—A special election will be held Aug. 4 to vote on the issuance of $800,000 of bonds for the purchase of the present or the construction of new works.

Staples, Minn.—A. L. Ritter informs us that a small fire protection system may be built, with pumping from the Northern Pacific Ry. Co's. well. Estimated cost, $6,000; bonds not yet voted.

Winthrop, Minn.—P. Quist informs us that bonds for works have been voted. Supply, deep well, pumping and stand-pipe. Population, 600.

Omaha, Neb.—The company has been ordered to extend its mains to supply the section known as Clifton Hill.

Schuyler, Neb.—The following is from W. T. Howard, Clerk:

Bids are wanted for works estimated to cost $25 0 0. A supply has been developed and will be pumped to a stand-pipe. Andrews & Burrell, Fremont, are Engineers. Population, 2 700.

Hot Springs, S. D.—A $30,000 works is projected, with a supply from a spring or an adjacent hill.

Butte, Mont.—The Council has canceled the contract between it and the Butte City Water Co., owing to objections to the bond filed. A legal contest is probable. E. M. Trask is at the head of a projected Elk Park Water Co. and proposes to ask for a franchise. He proposes to bring water from the Nez Perces Creek.

Livingston, Mont.—The Livingston Water Power Co. has been incorporated by J. C. Vilas, G. T. Chambers and others; capital, $250,000.

SOUTHWESTERN.

St. Louis, Mo.—Bids will be received July 21 by the Board of Public Improvements for 640 tons 6 and 12-in. cast-iron pipe, 15 tons specials, 19 6, 12 and 15-in stop valves and laying 11,500 ft. of 12-in. pipe. E. S. Foster is Secretary.

Helena, Ark.—A press dispatch states that the franchise granted some time ago to Moffett, Hodgkins & Clarke, of Syracuse, has been forfeited, and that other steps will be taken to secure works.

Fort Worth, Tex.—Plans and specifications for the proposed new city works have been completed by the American Water-Works Co. The city has authority to issue bonds.

Palestine, Tex.—New boilers, a 1,250,000-gall. pump and an 18 × 150-ft. stand-pipe will be added by the Palestine Water Co.

PACIFIC.

Spokane Falls, Wash.—Investigations for a new water supply are being made by City Engineer Oscar Huber and Capt. T. W. Symonds, Portland, Ore.

Tacoma, Wash.—Steps have been taken toward bonding the city for $1,500,000 for the purchase of the present works of the Tacoma Light & Water Co., or the building of a new system. The above company has bought the works of the Puyallup Water & Light Co., including the Maplewood Springs, about nine miles from Tacoma. It is said that new mains will be laid.

Portland, Ore.—The following is from A. J. Brownlie:

The Portland Heights Water Co. will begin construction July 15. Water will be pumped from a 10-in. main of the city works through a 6-in. main to an elevation of 750 ft. There will be a 250 000-gall. pump, a 50,000-gall. low and 30 000-gall. high service tank. The population to be supplied is about 1,000. G. P. Lent is Secretary and F. L. Fuller Engineer.

Sacramento, Cal.—A stand pipe is talked of.

Santa Barbara, Cal.—The stockholders have just voted to issue $150,000 of bonds to be spent for improvements at the discretion of the directors.

Salt Lake City, Utah.—The Council has voted to issue $50,000 of water bonds to extend the supply to the North Bench and Capitol Hill.

CANADA.

Wiarton, Ont.—The works are to be extended.

ARTESIAN WELLS.

New Orleans, La.—A well is projected, to be sunk in McCarthy Square, Third district.

South Bend, Ind.—Five wells are to be sunk by Stephenson Bros. for the city water-works.

Texas.—Wells are projected at Alvord, Caldwell, Brenham, Kaufman, Kosse and Waxahachie.

IRRIGATION.

Hastings, Neb.—The Hastings Irrigation & Improvement Co. has been organized to construct a canal from Lexington to Hastings, 20 miles. The proposed canal will tap the Platte River. A fall of about 35 ft. at Hastings will afford water power. Charles Benedict, Kearney, is interested.

Fremont and Uintah Co., Wyo.—Surveys for a 60-mile canal are being made by George Crofelt. Water will be taken from Fontenelle Creek.

Grand Junction, Col.—Efforts are being made to secure a subscription of $50,000 to put with a state appropriation of the same amount for a high line canal in Mesa Co. Recent surveys locate the head gates 8 or 9 miles from this place on the Grand River.

Harrisburg, Ore.—E. J. O'Connor has reported on three lines for a canal. The lowest estimate is $11,358 for canal 20 ft. wide on the bottom with 3 ft. of water.

Elsinore, Cal.—The Lake Elsinore Reservoir Co. proposes to irrigate large areas with water from the lake giving the company its name.

Lassen Co., Cal.—The following particulars are added to those given last week: The Honey Lake Valley Land & Water Co., according to the report of H. L. Taylor, of San Francisco, Engineer in charge, will take its supply from Long Valley Creek, which has a drainage area of 00 sq. miles in the Sierra Nevada Mountains. A dam and reservoir are projected at a point about 6 miles from the north of the creek. It is proposed to built the dam of earth, with a puddle core and to carry it to a height of 85 ft. This will make a dam 200 ft. long at the bottom, 900 at the top, where it will be 20 ft. thick. The reservoir thus formed would have a capacity of about 10,000,000 0 0 galls.

Modesto, Cal.—A contract has been made with the Grange Co., Modesto, for 10,000 bbls. of "K. B. & C." cement at $3.45 per bbl. for use in constructing the joint dam.

Temecula, San Diego Co., Cal.—M. L. Wicks, Los Angeles, has reorganized the Pauba Water Co. A system to irrigate the Pauba and Temecal grants, stated as 40,000 acres, is projected, with a large dam about 10 miles from Temecula.

Ogden, Utah.—Water for irrigation has been admitted to the Bear River Canal. Ogden, Corrinne and Bear River City will be supplied with water for city purposes. John R. Bothwell has been and S. Fortier will hereafter be chief engineer of the company.

New Companies.—Mesa Land & Improvement Co., Albuquerque, N. M., $500,000; Nimbres & Deming Canal Co., Deming, N. M., $250,000; Felix Land & Water Co., Lincoln, N. M., $100,000, to establish town sites, construct ditches and reservoirs.

SEWERAGE AND MUNICIPAL.

Sewers.—*New Hampshire.*—Laconia. The contract for sewerage extension has been awarded to F. E. Allen of Worcester, Mass. There will be about 55,000 ft. of pipe.

Massachusetts.—Cambridge. An appropriation of $15,000 has been made for sewers.—Pittsfield. The contract for the east side main sewer has been awarded to Malloy Bros., of New Rochelle, N. Y., at $28,300. The contract for pipe has been awarded to W. G. Backus' Sons, manhole castings to the Ramapo Iron Works, and iron pipe to W. D. Wood & Co.—Springfield. The report by Mr. Rudolph Hering on the sewerage system has been presented.—Clinton. An appropriation of $19,000 has been asked for sewers.

Connecticut.—Meriden. Mr. T. H. McKenzie, of Southington, is preparing plans and estimates for a sewerage system, including sewage disposal by irrigation and filtration through land.

West Virginia.—Huntington. Mr. Thornburg, City Engineer, has prepared plans for about 5 miles of main and branch sewers, and the city will advertise for bids. The sewers are to be built before the brick paving already contracted for is built.

Kentucky.—Lexington. The Mayor proposes that the city shall purchase sewer pipe and have it laid by its own laborers.

Ohio.—Paulding. A sewer contract for $27,000 has been let.—Mansfield. A Waring system of sewerage is to be put in.

Minnesota.—Hamline. The citizens' committee is agitating for sewerage.

Iowa.—Sioux City. Mr. Loweth, of St. Paul, has estimated the cost of the sewer to carry the waters of Perry Creek into the Missouri River at $765,000. It would be 25 ft. diam. and 6 15- ft. long.

Missouri.—St. Joseph. Work will soon be commenced on the Blacksnake sewer. The city will pay $50,000 and the railway company $50,000.

Montana.—Missoula. Surveys for a sewerage system are being made by Mr. Reardon, City Engineer.

Oregon.—Portland. Contracts are to be let for the Thomas Creek and Tanner Creek sewers, at about $32,000 and $41,000 respectively.

Nevada.—Carson. The City Trustees have awarded a contract to J. K. Carpenter, of San Francisco, Cal., for laying 27,000 ft. of 6 and 8 in. pipe.

Streets.—*New York.*—Elmira. Brick paving is to be tried.

New Jersey.—Atlantic City. A new street grade ordinance has been passed, but paving will not be commenced until September.

Pennsylvania.—Norristown. It is proposed to adopt brick paving, and a special committee has visited Philadelphia, Pa., and Columbus, O.

Tennessee.—Chattanooga. Contracts have been awarded for street work to the extent of $250,000.

Florida.—Jacksonville. A proposition has been made by Mr. M. Hays to lay heart cypress block paving and to guarantee the same for 11 years, at 85 cts. per sq. yd.

Ohio.—Barnesville. Brick paving has been adopted.

Indiana.—Indianapolis. About $23,000 will be spent on brick and asphalt paving.

Missouri.—Kansas City. Gravel paving is being laid by the Kansas City Gravel & Tile Co. The foundation is of telford paving, covered with 6 ins. of macadam and 6 ins. of gravel.

California.—Sacramento. About $18,000 will be spent on stone sidewalk.

Ontario.—Guelph. The city has adopted the report of the Board of Works recommending a system of improved paving, to be carried out under the supervision of an engineer to be appointed by the city.

Bonds.—Redwood, Cal.; $35,000 for sewers. Covington, Ky.; $150,000 for streets. Providence, R. I.; $75,000 for sewers. Spokane, Wash.; $1,200,000 muncipal bonds, $500,000 for water-works, $700,000 for bridges. Richmond Co., N. Y.; $150,000 for roads. Columbus, O.; $220,000 for streets; bids received July 15 by the City Clerk. Dayton, O.; $38,000 for sewers; bids received July 27 by C. A. Herbig, City Auditor. Detroit, Mich.; $1,000,000 for sewers. Johnstown, Pa.; $100,000 for streets. Highlands, Col.; $40,000 for sewers.

ELECTRICAL.

Electric Light.—New plants or extensions are reported as probable in Providence, R. I., address the Narragansett Electric Co.; Baltimore, Md., address the Jarvis-Conklin Mortgage & Trust Co., of Kansas City, Mo.; Batesville, Ark.; Bethany, Mo.; Madison, Ind.; Fort Hunter, N. Y., address E. Howard & Son; Luling, Tex.; Lachine, Ont.; Ailentown, Pa., address the Electric Light & Power Co.; Washburn, Wis.; Ishpeming, Mich.; Pioche, Nev.; Asnville, Ala., address J. A. Hodges; Yazoo City, Miss.; Loveland, Colo.; Manchester, Va., address H. S. Bradley; Baltimore, Md., address the Park Commission; Florence, Ala., address W. P. Campbell.

Waterville, Me.—The town has appropriated $20,000 for a municipal plant.

North Attleboro, Mass.—At a town meeting held June 31, it was decided by a vote of 245 to 35 to construct and operate a municipal plant.

Waynesboro, Pa.—The Borough Council has, it is said, made a contract with the Electric Light Co. for 17 arc lights at $80 per year, 32 c. p incandescent lamps at $20, and 100 c. p. lamps at $60.

Gaithersburg, Md.—The Gaithersburg Milling & Mfg. Co. will need a dynamo to furnish electric light.

Waynesboro, Va.—The Waynesboro Street Railway, Light & Water Co. want prices on a 600 incandescent 16 c. p. dynamo.

Tallapoosa, Ga.—The Vernon Light & Power Co. will purchase a dynamo.

Denver, Col.—According to *Light, Heat and Power*, the city has practically accepted the bids of the Consolidated Electric Light Co. for the next two years. The city will be furnished with incandescent lights on the all-night schedule at $2.16⅔ per month, and arc lights in the central parts of the city for $12.50 per month. Outside the present incandescent districts arc lights will be supplied at $10.

Stratford, Ont.—Sealed bids for street lighting will be received until July 15 by Wm. Hepburn, Chairman of the Fire, Water and Light Committee of this town. Tenders to state rate for 70 lights of 2,000 c. p. or 100 lights of 1,500 c. p.

New Companies.—Columbian Light, Heat & Power Co., Chicago, Ill.; capital stock, $3,000,000; incorporators, N. A. Partridge, S. E. Moore, J. Irvine. National Light, Heat & Power Co., Chicago, Ill.; capital stock, $100,000; incorporators, H. M. Angle, C. Arnold, P. E. Crissey. Kennebunk (Me.) Electric Light Co.; capital stock, $100,000; President, S. T. Fuller; Treasurer, F. M. Ross. Central Construction Co., Newport, Ky.; capital stock, $500,000; W. W. Taylor, of Philadelphia, Pa., is an incorporator; object, construction of water-works, electric light plants, etc. Westfield (N. J.) Investment & Improvement Co.; capital stock, $50,000; incorporators, M. Welles, J. H. Vail, W. G. Delamater and others; object, construction and operation of an electric station. Millville (N. J.) Electric Co.; capital stock, $50,000; incorporators, W. D. Kemble, G. B. Langley, W. Wobd. Crescent Electric Light Co., Long Island City, N. Y.; capital stock, $25,000; directors, G. Gray, Jr., E. P. Foster, H. A. Fisher, Jr. Bridgeport (Ala.) Electric Light & Ice Co.; capital stock, $60,000. Mountain Electric Light & Supply Co., Butte City, Mont.; capital stock $50,000; incorporators, H. C. Kessler, J. O'Rourke, W. Orvsley. Leesburg (Fla.) Electric Light & Water Power Co.; capital stock, $50,000; G. C. Stapylton, President. Southern Electric Co., Lynchburg, Pa.; capital stock $1,000; incorporators, C. P. and C. W. Poole, R. H. Pennill and others. Shenandoah Electric Light & Power Co., $15,000; capital stock, $15,000. Plattville Electric Light & Power Co., Plattville, Wis.; capital stock, $10,000.

CONTRACTING.

Cranes.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has received the following proposals for two 40-ton locomotive cranes at the Norfolk and New York navy yards for handling the armor plates for the new battle-ships. Wm. Sellers & Co., Philadelphia, Pa., $55,465; Southwark Foundry & Machine Co., Philadelphia, Pa., $71,522; American Ship Windlass Co., Providence, R. I., $77,708; Morgan Engineering Co., Alliance, O., $79,966; Yale & Towne Mfg. Co., Stamford, Conn., $92,200; Weimer Machine Co., Lebanon, Pa., $104,360. The contract was awarded to Wm. Sellers & Co. It is said that these will be the most powerful cranes ever built in this country.

Pipe.—*Rochester, N. Y.*—The contract for cast iron pipe and special castings has been awarded by the Water Department to the Jackson & Woodin Mfg. Co., of Berwick, Pa., at $23.20 per ton for 12, 10, 8 and 6 in. pipe, $23.70 for 4 in. and 2½ cts. per lb. for castings. The contract amounts to $15,205.

Dredging.—*Petaluma, Cal.*—The U. S. Engineer Office has awarded a contract for dredging in Petaluma Creek to M. J. Miller & Co. at 15 cts. per cu. yd. Bids ranged from 15 to 22 cts.

Street Work.—*Albany, N. Y.*—The contract for paving Quail St. has been awarded to Jacob Holler: granite block paving, $2.78 per sq. yd.; curb, 60 cts. per ft; circular curb, 95 cts.; crosswalks, 19 cts. per sq. ft.; cobblestone, 55 cts. per sq. yd.

Indianapolis, Ind.—The Board of Public Works recently received bids for asphalt paving, the prices of which ranged as follows: Warren-Scharf Asphalt Paving Co., New York, $5.14 to $8.07 per front ft. with limestone curb, $5 39 to $8.27 with oolitic curb. Western Paving & Supply Co., $5.12 to $7.97 per front ft. with limestone curb; $4.45 to $8.25, with oolitic curb.

Reservoir.—*Rutland, Vt.*—Proposals have been received by the Water Committee for the construction of a reservoir of 6,000,000 galls. capacity. The bidders were as follows: *A*, Flood & Sherrill, Sandy Hill, N. Y.; *B*, R. H. Rogers, Plattsburg, N. Y.; *C*, Troy Public Works Co., Troy, N. Y.; T. F. Amory & Co., Poughkeepsie, N. Y.

	Excavation.			Cut stone masonry in Portland cement.	Rubble masonry in Portland cement.	Rubble masonry in Rosendale cement	Concrete, Rosendale cement.	Paving, laid dry.	Pipes in place.	Gate-house, complete above foundation	Total.
	Earth.	Solid rock	Loose rock								
	Cu. yd. cts.	Cu. yd. $	Cu. yd. cts.	Cu. yd. $	Cu. yd. $	Cu. yd. $	Cu. yd. $	Cu. yd. $	$	$	$
A	42	7.0	42	15	6.75	5.30	6.00	1.75	750	300	17,997
B	52	1.00	50	10	7.60	6 00	7.00	1.00	700	700	19,690
C	45	4.00	90	25	9.00	7.00	6.00	2.00	700	200	22 700
D	50	1.00	50	12	10.00	7.00	5.50	3.50	1,000	250	24,584

Sewers.—*Springfield Mass.*—Contracts have been awarded as follows by Mr. C. M. Slocum, City Engineer: Wason Ave. sewer: G. M. Atkins & Co., Palmer, Mass.; 46 × 69 ins., $7; 40 × 60 ins., $6.35; 38 × 57 ins., $5.40; 24 × 36 ins., $4; manholes and inlets, $40; total, $16,929. Fort Pleasant and Sumner Ave. sewer: Geo. M. Atkins & Co.; 28 × 42 ins., $1.60; 24 × 36 ins., $3.90; 22 × 33 ins., and 20 × 30 ins., $3.80; 18 × 27 ins., $3.30; manholes and inlets, $40; catch-basins, $50; total, $21,131

PROPOSALS OPEN.

Wood Paving.—*Cleveland, O.*—About 3,100 sq. yds. of wood pavement on Kingsbury Run viaduct, and 2,100 sq. yds. on Superior St. viaduct; also, 150,000 ft. B. M. of flooring plank. All to be of long leaf southern pine. R. R. Herrick, Director of Public Works. July 2.

Water-Works.—*St. Louis, Mo.*—Low-service conduit, 13 000 cu. yds. excavation, 1,500 cu. yds earth, 3,700 cu. yds concrete, 2,200 cu. yds. brick masonry, 18,500 sq. ft. granitoid, 100 lin. ft. 36 in. cast-iron pipe culvert. Also, 640 tons 6-in. and 12-in. cast-iron coated water pipe, and 15 tons specials; 19 stop valves; laying 11,800 lin. ft. of 12-in. and 100 lin. ft. 6-in. pipe. Board of Public Improvements. July 21.

Railway.—*Boston, Mass.*—Grading railway near proposed Basin No. 5 of the water-works. The Park Commissioners. July 14.

Sewers.—*Cleveland, O.*—R. R. Herrick, Director of Public Works. July 15.

Pontiac, Ill.—Brick sewer, 1¼ miles. The City Clerk. July 16.

Bridge.—*McMinnville, Tenn.*—Highway bridge, 155 ft. span. W. J. Kirkpatrick, Berry Block, Nashville, Tenn. July 24.

Public Buildings.—*Beaufort, S. C.*—County jail, $6,000. Jail Commissioners. Aug. 1.

Gaylord, Mich.—Brick courthouse, jail and residence. Architect, F. M. Hollister, Saginaw, Mich. Frank Randolph, Chairman of Building Committee, Otsego Co. Board of Supervisors. July 15.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have built a tank engine for the Wilmington Seacoast R. R.; the tank has a capacity of 3,000 galls. They are also building some decapod engines for the New York, Lake Erie & Western R. R.; cylinders 24 × 28 ins., boiler 76 ins. diameter. The Brooks Locomotive Works, of Dunkirk, N. Y., have completed 9 engines for the Cincinnati, Hamilton & Dayton; the rare building 10 for the Lake Shore & Michigan Southern and 1 for the Standard Oil Co. The Dunkirk Engineering Co., of Dunkirk, N. Y., has built a logging engine weighing 8 tons for a North Carolina lumber firm.

Cars.—The Jackson & Sharp Co., of Wilmington, Del., has built 5 parlor cars for the Concord & Montreal. The St. Louis Car Co., of St. Louis, Mo., is building 25 closed street cars for the Union Depot line; they will be 34 ft. long, seating 80 passengers. The Wason Mfg. Co., of Springfield, Mass., is building 8 passenger cars for the Central Vermont.

Station.—The Old Colony R. R. is building a stone station at South Braintree, Mass.

The H. W. Johns Mfg. Co., of New York, N. Y., has now had consolidated with it the Chalmers-Spence Co., the Asbestos Packing Co., Chas. W. Trainer & Co., and the Shield & Brown Co. The manufactures of these companies will be made and sold by the main company, which will establish extensive new asbestos works this year.

The Ingersoll-Sergeant Drill Co., of New York, has started up a bar-channeler at the Diamond slate quarry, Pen Argyll, Pa., with a counterbalance where the rock runs very slant, and the machine is said to be cutting an average of 65 ft. per day with the rock dipping 30°. A bar-channeler at Bangor, Pa., is cutting 90 ft. per day, and making 3,000 instead of 2,500 squares per month, at a saving of 25 cts. per square or $750 per month. Other orders have been placed.

Companies.—Central Construction Co., Newport, Ky.; to construct water-works, electric light plants, street railways, etc.; W. S. Coon and Allen Smalley, of Wyandotte Co., O., and W. W. Taylor, of Philadelphia., Pa.; $500,000. Cumberland and Unaka Iron & Steel Co., of Knoxville, Tenn., to operate the Conley steel process; J. L. Murphy, president, Standard Air Brake Co., of East St. Louis, Ill.; George E. Paul, F. Deseman and C. M. Linhart; $400,000. Atlanta Iron & Steel Casting Co., of Atlanta, Ga.; to operate the Bates steel process; Edward Van Winkle, President; $500,000. Streator Paving Brick & Tile Co., of Streator, Ill., C. Evans, W. Russell and John Evans; $60,000. Oxy-Hydro Carbon Light, Heat & Power Co., of Camden, N. J.; M. Gardner and Alex. Gray; $1,100,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $20.50 for iron and $17 for steel. Pittsburg: $30; old rails, $23 to $23.25 for iron and $17.50 to $18.50 for steel. Chicago: $31 to $32; old rails, $23 to $23.25 for iron and $14.50 to $15.50 for steel.

Track Materials.—New York: steel angle bars, 1.7 to 1.8 cts.; spikes, 2 to 2.1 cts.; track bolts, 2.65 to 2.8 cts. Pittsburg; splice bars, 1.8 to 1.9 cts. for iron or steel; iron or steel spikes, 2.1 cts.; iron track bolts, 2.75 cts. with square and 2.85 cts. with hexagon nuts. Chicago: splice bars, 1.8 to 1.9 cts. for iron, 2 cts. for steel; spikes, 2.15 to 2.2 cts.; track bolts, 2.8 to 2.9 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.50 to $17. Chicago: $14 to $18.50.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 55 and 45 per cent. on black and galvanized butt-welded; 65 and 5-2½ on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.45 to 4.5 cts. Chicago: 4.25 to 4.35 cts St. Louis: 4.3 to 4.35 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1 95 to 2.1 cts.; tees, 2.45 to 2 75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.65 cts.; sheared steel bridge plates, 2.1 to 2.15 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.1 cts. for tank, 2.4 cts. for shell, 2.6 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.1 to 2.15 cts.; tees, 2.6 to 2.7 cts. universal plates, 2.15 to 2.2 cts.; sheared plates, 2.3 to 2.4 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.4 to 2.6 cts. for tank, 2.85 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.